THURSDAY, MAY 21, 1896.

SOCIOLOGY.

The Principles of Sociology; an Analysis of the Phenomena of Association and of Social Organisation. By Franklin Henry Giddings, M.A., Professor of Sociology in Columbia University in the City of New York. Pp. xvi + 476. (New York and London: Macmillan and Co., 1896.)

WITH extensive learning and a good deal of original speculation, Prof. Giddings has written a very useful general introduction to sociology. The scope and nature of this recently established science are not yet well understood, and hitherto it has been difficult to refer to any one book from which they could be learnt; for Comte is out of date; Mr. Spencer's great work is still incomplete, though already rather terrifying in its proportions; and the greater part of the information obtainable on the subject must be sought in innumerable monographs on primitive law, marriage, religion, art, in volumes, essays, and the journals of learned societies. In the present volume, however, the most interesting lines of sociological inquiry are indicated, and the best ascertained results are collected, critically examined, and scientifically arranged within a moderate compass.

The preliminary discussions of the province of sociology and its logical methods of research, attest the care with which the author has prepared for his task by studying the physical sciences. Some passages in chapter iii., on method, may perhaps be considered fanciful, but they do not prevent his coming to sound conclusions.

The second book is descriptive and classificatory, dealing with the facts of population, its growth, diffusion, and localisation; with the social mind, its traditions and standards (there is no mysticism about it); with social composition according to tribes and nations, and social constitution or organisation for government, industry, &c.

Then follows an investigation of the history of society; the place of man's origin, the origin of races, and of the great groups of ideas that constitute law, art, religion, &c.; the growth of the tribe in its metronymic and patronymic forms, and finally of civilised peoples.

The fourth and last book formulates the ultimate causes and laws of social evolution, as objectively a conflict of physical forces tending to equilibrium, and subjectively the production of personality and of forms of association that partly result from and partly determine the characters of human beings.

The treatment throughout is scientific: it is well proportioned, and fully illustrated from history and anthropology. If fault must be found, it may perhaps be said that there are some needless pages in Book iii. chapter ii., where Prof. Giddings tries to frame hypotheses as to the birthplace of our race and the origin of races; inquiries which, in the present state of our knowledge, can only lead to a submerging of the halfpennyworth of fact by floods of speculation. And the first chapter of Book iv., on the physical interpretation of the social process, should be much expanded and illustrated. As it stands, it is intelligible only to trained readers.

There are also, of course, in so comprehensive a work, a good many disputable positions, two of which may be selected for special comment. In Book iii. chapter iv., on demogenic association, Prof. Giddings distinguishes three stages in the growth of civilised societies: (1) the Military-Religious, (2) the Liberal-Legal, (3) the Economic-Ethical. Noticing previous attempts to demarcate such epochs of progress, he complains that Hegel's doctrine of successive steps in the acquisition of freedom or self-realisation, and Comte's "law of the three states," are alike one-sidedly subjective, and fail to give any account of the structural changes of society. Mr. Spencer, again, recognises only two stages, the military and industrial, corresponding on the whole to (1) and (3) of the author's own divisions. But this criticism rests upon an oversight with regard to Comte. Turning to Comte's chapters on sociology, it will be seen that the indication of the military and industrial stages of society is due to him. He regards them as naturally coinciding respectively with the theological and positive stages of explanation; and, further, he indicates an intermediate phase of social organisation similar to Prof. Giddings' (2), the Liberal-Legal, and naturally coinciding with the age of metaphysical explanation. This intermediate stage, however, in both organisation and explanation, he treats as essentially transitional and as wanting the relative stability of militarism and industrialism. How comparatively unimportant it is in universal history (though important to us who have not yet escaped from it), may be seen at p. 301 of this work, where its extent in modern history is indicated as dating from the Renaissance: 500 years! Merely a list of revolutions! Mr. Spencer seems to be fully justified in not giving to this unstable period the rank of those forms of culture of which one endured, and the other may endure, for thousands of generations. As for Comte, he has been adulated and repudiated enough, and would now gain much by getting bare justice.

Again, in his first chapter, Prof. Giddings, after observing that sociology, having for its object phenomena which, on the one hand, may be viewed as a redistribution of matter and motion, and, on the other, as effects of knowledge and volition, must seek its explanations in the co-operation of physical and psychical causes, according to laws subjective and objective, coinciding and verifying one another, goes on to say that he accepts Mr. Spencer's objective interpretation of the social process, as a "formal evolution through the equilibration of energy," but that an adequate conception of the process on the subjective side is still wanting. He then offers to supply the want thus:—

"The original and elementary subjective fact in society is *the consciousness of kind*. By this term I mean a state of consciousness in which any being, whether low or high in the scale of life, recognises another conscious being as of like kind with itself" (p. 17.)

But surely this cannot be the fact he is in quest of; for the "consciousness of kind" is mainly a fact of perception; whereas what he needs is something corresponding to the physical energy that moulds societies considered objectively, and this subjectively can only be a fact of volition. The fact that is wanted, moreover, must not only correspond with the physical cause of the

social process, but also in its consequences with the physical result, namely, the establishment of a moving equilibrium. Both these requirements are met by our old-fashioned friend utility: desires are the psychical causes; and the maximum satisfaction with the nearest approach to equal conditions, may one day correspond with the nearest approach to equilibrium. No doubt the consciousness of kind is a condition of the development of social life, as in the phenomena of sympathy and (to take the social process pretty early) in bisexual generation. But it may be presumed that the consciousness of kind, sympathy, and bisexual generation are all subordinate to objective utility (survival), or they could never have existed at all; and the connection of subjective with objective utility through the laws of pleasure and pain is well known.

It is a pleasure to add that this unpromising theory at the outset of the book does very little harm in the sequel, and by no means prevents the author's knowledge and penetration from producing very interesting and instructive work.

CARVETH READ.

COCOA CONNOTATIONS.

Cocoa: All about It. By Historicus. Pp. 99. (London: Sampson Low, Marston, and Co., Limited, 1896.)

IN this book the author has managed to justify his title, for if he has not reproduced *all* that has been written and said about cocoa, he has strung together a large number of extracts from early records referring to its history, cultivation, and uses. About one-half the book is devoted to these subjects, and the remainder to the manufacture, the value of cocoa as food, its adulterations, and finally a few pages to the subject of vanilla as a flavouring agent to chocolate.

The chief interest of the book, however, will be found in the first two chapters, namely, "The History and Cultivation of the Cocoa Plant," and "History of the Use of Cocoa"; and we say this advisedly, for the author has apparently been at some pains in collating these extracts, which do not appear in every essay on cocoa, while cocoa manufacture, its value as food, and its adulterations have been the subject of many themes since it has become such a popular and wide-spreading beverage. It may be a surprise to some persons to know that though cocoa is a comparatively modern drink with us, it was well known to the early Mexicans. The author says: "Our knowledge of cocoa as an article of diet dates from the discovery of the Western World in 1494 by Columbus, who, we are told, took home with him samples of the article; and from the subjugation of Mexico by Cortez in 1521. History informs us that the Spaniards were the first who tasted chocolate, which was part of their spoil in the conquest of Mexico." An additional tribute to the early use of cocoa is given from a MS. in the British Museum, "written in Old English characters and entitled 'A Voyage to the West Indies and New Spain' (Yucatan) made by John Chilton in the year 1560. He says: 'So we were provided of victualls till we came where Townes were in the province of Soconusco, where groweth Cacau, w^ch the Christianes carrye from thence unto Nova Hispaniola because y^t will not grow in a cold countrye. . . . Their chiefest marchandize is Cacau.'" It is not a little remarkable that one of the finest qualities of cocoa at the present time is produced at Soconusco on the coast of Guatemala. The following extract from an account of the rise and growth of the West Indies, written in 1690, is given as showing an early attempt and failure by the English to cultivate cocoa.

"Cocoa," it is said, "is now a commodity to be regarded in our colonies, though at first it was the principal invitation to the peopling of Jamaica, for whose walks the Spaniards left behind them there, when we conquered it, produced such prodigious profit with so little trouble that Sir Thos. Modiford and several others set up their rests to grow wealthy therein, and fell to planting much of it, which the Spanish slaves had always foretold would never thrive, and so it happened, for though it promised fair, and throve finely for five or six years, yet still at that age when so long hopes and cares had been wasted upon it, withered and died away by some unaccountable cause, though they imputed it to a black-worm or grub which they found clinging to its roots, and did it not almost constantly die before, would come into perfection in fifteen years' growth and last till thirty, thereby becoming the most profitable tree in the world, there having been £200 sterling made in one year of an acre of it. But the old trees being gone by age, and few new thriving as the Spanish negroes foretold, little or none now is produced worthy the care and pains in planting and expecting it. Those slaves gave a superstitious reason for its not thriving, many religious rites being performed at its planting by the Spaniards, which these slaves were not permitted to see. But it is probable that where a nation, as they, removed the art of making cochineal and curing vanilloes into their island provinces, which were the commodities of those islands in the Indians' time, and forbade the opening of any mines in them for fear some maritime nation might be invited to the conquering of them, so they might likewise in their transplanting cocoa from the Caracas and Guatemala conceal wilfully some secret in its planting from their slaves, lest it might teach them to set up for themselves, by being able to produce a commodity of such excellent use for the support of man's life, with which alone and water some persons have been necessitated to live ten weeks together without finding the least diminution of health or strength."

The value in which cocoa is now held as an article of diet, seems from the foregoing paragraph to have been established so long ago as 1690, and its cultivation and consumption still goes on at a marvellous rate. The processes of collecting the pods, extracting the seeds, fermenting, drying, &c., which are more or less generally known, are carefully detailed in the succeeding pages, and it is pointed out that if well cured a cocoa-bean should have the outer skin hard, crisp, and separating easily from the seed inside, which should be firm, bright, and should break readily on pressure, forming the familiar cocoa-nibs of commerce.

On the subject of adulteration, to which cocoa and chocolate lend themselves so readily, and to which so much attention has of late years been drawn, it is curious to note the following paragraph.

"So far back as 1640 in 'A Curious Treatise of the Nature and Quality of Chocolate,' by Antonio Colmenero, which was translated from the Spanish into English, there are some remarkable statements as to the value of chocolate, but the writer recognises the mischief that

adulteration had already done. He says: 'Those who mix maize in the chocolate do very ill, because these grains do beget a very melancholy humour, and those which mix it in this confection, do it only for their profit.'"

The book is illustrated by numerous full-page and smaller illustrations, and is well printed on thick, glazed paper.

THE CHEMISTRY OF ENGINEERING.

Chemistry for Engineers and Manufacturers. A Practical Text-book. By Bertram Blount, F.I.C., F.C.S., and A. G. Bloxam, F.I.C., F.C.S. Volume I. *Chemistry of Engineering, Building, and Metallurgy.* Pp. x + 244. 35 illustrations. (London: Charles Griffin and Co., Limited, 1896.)

THIS book gives a general view of chemical technology, and is intended for the use of engineers, managers of works, and students. It is meant to be read, and not to be treated as a book of reference, and therein differs from the larger works which have already covered the same ground. The authors have confined themselves to explaining the general chemical principles underlying each process, working details and exact descriptions of plant being omitted. Thus the manager of works engaged on a particular process can probably, by perusing this book, find out as much as he desires about any other typical process, although it is perhaps unlikely that he will learn from it much regarding his own business. It is to be regretted that in pursuance of their plan of avoiding all semblance of a book of reference, the authors have in no case indicated where further information can be obtained to supplement their own accounts. The volume is divided into two parts, the first part dealing with the chemistry of engineering and building, and the second with metallurgy. These two parts are very unequal in merit, the first being what it claims to be, a practical treatise, which will doubtless be much appreciated by manufacturers. In this part the accounts given of fuels, and particularly that of gaseous fuel, are useful summaries, and the chapters on steam-raising and on lubricants contain a considerable amount of practical information. These sections will be of value in enabling an owner of machinery or user of power to detect causes of waste, and to realise when saving may be effected by calling in expert assistance.

The part devoted to metallurgy is much less satisfactory. It is evident that, as the attempt has been made to compress an account of the whole art into 104 pages, only the barest outlines of the various processes could be given. Among the unfortunate results of this are that the Patio process for extracting silver from its ores, and the cyanide process for extracting gold, are each dismissed in half a page, though in these cases the chemical actions are complicated and the mechanical arrangements of secondary importance. Such paragraphs serve no useful purpose. There are more mistakes in this part than should have been allowed to creep in, this constituting another point of difference between the two parts. For example, in describing the wet process of copper extraction, the reason for preventing the temperature from rising much above 38° C. is incorrectly stated, the true reason being that the production of ferric salts is favoure by higher temperatures; moreover, a little-used method of keeping down the percentage of ferric salts in the solution is given, while no allusion is made to the ordinary one, viz. the passage of the liquid through a layer of cupriferous pyrites, rich in copper. Again, on p. 214, sulphurous acid is given as one of the agents used to precipitate gold from the solutions obtained in the chlorination process, the fact being that it is only employed to prepare solutions for the passage of sulphuretted hydrogen, which is not mentioned. It may be a hard saying, but there is little doubt that the whole book would have been improved if the part on metallurgy had been left out. Space could then have been found to expand here and there the first part, which, excellent as it is, might thus have been made still more useful.

OUR BOOK SHELF.

Elementary Practical Physics. By William Watson, B.Sc. (London: Longmans, Green, and Co., 1896.)

Elementary Practical Chemistry. By G. S. Newth, F.I.C. (London: Longmans, Green, and Co., 1896.)

WE have long deplored the unfortunate division between theoretical and practical chemistry in many schools and classes, and have been convinced that, alike for educational and utilitarian purposes, physics was a neglected instrument; therefore, very heartily do we welcome the new movement of which these books are a manifestation.

Each volume is described on its title-page as a "laboratory manual for use in organised science schools." Each is written to the new syllabus of the South Kensington Science and Art Department, and each gives excellent directions for setting up (and often for constructing) apparatus, and for taking observations to demonstrate the chief phenomena, and to verify the fundamental laws, of chemistry and physics respectively. In the physics we are glad to see that nearly all the experiments are of a quantitative character; in the chemistry this is far less often the case, partly owing, doubtless, to the nature of the subject. In both works the experiments are judiciously chosen, carefully described, and well illustrated, and in many cases strikingly original.

One criticism of principle may be made. Mr. Newth says: "In a text-book it is almost inevitable that in giving such directions as will lead a student on to the discovery of a fact, the fact itself shall be stated." He may be right in this; but if so, it appears to afford an argument against the use of such text-books in the laboratory at all, for, speaking generally, the most valuable exercise of all for the student is the study of his recorded observations, and the endeavour to deduce therefrom the property or law they demonstrate. Is not the getting up of a proposition of Euclid a smaller intellectual feat than the solution of a "rider"?

Especially does this principle of research appear to be applicable to the laws of elementary physics; but Mr. Watson apparently endorses Mr. Newth's view.

With this reservation, we cordially recommend both these volumes to the notice of teachers of elementary science. From the point of view taken, the work has been well done in both cases, and the books reflect credit alike on authors and publishers. C. H. D.

A Text-Book of the Science and Art of Bread-Making. By William Jago, F.I.C., F.C.S. Pp. 618. (London: Simpkin, Marshall, Hamilton, Kent, and Co., 1895.)

THE practical application of science to the arts and trades has been one of the most notable features of the present century, with the almost universal result of

raising the standard of the articles made, and at the same time of improving the prosperity and health of those who are employed in making them. The volume now before us shows the application of science to the art of bread-making, and a glance at its size and contents will at once show all those who are entering into this business that there is a very large amount of scientific knowledge required to equip a man efficiently to succeed in the keen competition of the present day.

The chemistry of the subject is very fully dealt with, with valuable suggestions for practical work; and we have also a chapter on bacteriology, in which the history of our present knowledge of fermentation is clearly given up to date. Fermentation is, of course, an important process in bread-making, and a chapter on technical researches in this subject is given. The use of the microscope is also pointed out in the examination of different starches, &c. In addition to these principles, which may be said to form the groundwork of the subject, the more practical side also finds a place, such as commercial testing of wheat and flours, different methods of baking, both by machinery and otherwise; and, lastly, there are a few paragraphs on adulterations and the methods for recognising them. Numerous good illustrations are scattered throughout the book. This work will doubtless appeal to all those connected with the business of bread-making, and we imagine it will also find a place on the book-shelves of many medical and other scientific men.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Koch's Gelatine Process for the Examination of Drinking Water.

DR. EDWARD FRANKLAND, in a discourse delivered at the Royal Institution on February 21 (see NATURE, April 30), paid a just tribute to the work of the late Dr. Angus Smith, for he stated that Dr. Koch's invention was first made known and practised in England in 1882 by Dr. Angus Smith.

On the other hand, Dr. Percy Frankland has put forward a claim, in his work on "Micro-organisms in Water" (page 119), that Koch's method was introduced into this country by himself—a claim reiterated in his evidence before the Royal Commission on Metropolitan Water Supply at Question 11099 (Prof. Dewar). "I believe you tell us that you were the first person in this country who adopted the Koch method, and applied it to the London Water Supply?" "Yes, that is so."

As I was scientific assistant to the late Dr. Angus Smith, and worked with him on Dr. Koch's gelatine method, I should like to state that not only was the method applied by Dr. Angus Smith to the London Water Supply in February 1883, but also to a variety of waters from different parts of the country. The results of Dr. Angus Smith's work are to be found in the second Report of the Local Government Board R.P.P. Act, 1876.

Ellerslie, Alderley Edge, May 6. FRANK SCUDDER.

I AM much indebted to Mr. Scudder for furnishing an opportunity for calling attention to a misapprehension which appears to exist in some quarters as to the time and manner in which Dr. Koch's method of water examination by the process of gelatine-plate-culture was introduced into this country, as but for his letter I should not have thought it worth while to discuss a matter which must be sufficiently well known to all who are really conversant with the development of bacteriological inquiry in Great Britain during the past fifteen years. In the first place, I would point out that in making the statements referred to by Mr. Scudder, I did so with the full cognisance of the late Dr. Angus Smith's work as published by him in his second Report to the Local Government Board, and in an article of his which appeared in the *Sanitary Record* in 1883. In this work I was so much interested that I at once, in the same year, set about applying the method described by Dr. Angus Smith to a number of the samples of London and other waters which were being subjected to analysis in my private house at the time. These experiments yielded, however, such indefinite and unintelligible results that I entirely abandoned Dr. Smith's process, and it was not until the summer of the following year (1884) that I became really acquainted with Koch's method of plate-cultivating bacteria through the now classical demonstrations given by Mr. Watson Cheyne at the Health Exhibition. It was this method of gelatine-plate-culture which I then immediately applied to the investigation of a number of problems connected with the bacterial purification of water by filtration, precipitation, &c., both on the laboratory and on the industrial scale, and the results of which I placed in the hands of the Royal Society in May 1885, in a paper entitled "The Removal of Micro-organisms from Water." It is this paper which I believe to be the first published account in this country of the application of what is now universally understood as "Koch's gelatine-plate-process" to the examination of water, and the first to contain numerical determinations of the bacteria present in a given volume of the various waters supplied to London. In the autumn of the same year (1885) I undertook, at the request of the late Sir Francis Bolton, then Water Examiner for the Metropolis, to make for the Local Government Board regular monthly examinations by this process of the various waters, both before and after filtration, supplied by the several London Water Companies, and the results of these were regularly published in the monthly reports issued by the Local Government Board.

That I do not stand alone in viewing Dr. Angus Smith's method and that of Dr. Koch as distinct, will be apparent from the following words, extracted from Dr. Smith's above-mentioned Report to the Local Government Board:—"I do not know, even now, if I employ the method which Dr. Koch would consider the best, but the book on the subject promised by himself and his coadjutor not having appeared, I consider myself liberty to proceed with my inquiries"; and in point of fact, if any competent bacteriologist will take the trouble to read Dr. Angus Smith's report, he will see that although both processes of course involve the use of gelatine, they are in many important respects widely divergent. In the first place, the medium employed by Dr. Angus Smith contained gelatine only, and was destitute of the nutrient constituents—meat-broth and peptone; so that the appearance of colonies in his process would thus partly depend upon the chemical composition of the water, a condition of things which tends to defeat the object in view, viz. the discovery of the living as distinguished from the dead and unorganised matter in the water. Indeed Dr. Angus Smith distinctly deprecates rendering the medium more nutritive, *e.g.* by the addition of sodium phosphate and sugar, which he employed in some of his experiments. On the other hand, one of the cardinal principles of Koch's method is the use of as highly nutrient a medium as possible, so as to render the cultivation results absolutely independent of the chemical composition of the water. Again, of fundamental importance in the Koch method is the cultivation in such a thin stratum of the solid medium that all parts of it shall be practically under identical conditions and plentifully supplied with oxygen. Dr. Angus Smith, on the other hand, cultivated in test-tubes eight inches in depth, and the disadvantage of this he appears to have himself realised, as he points out that the cultures of very impure waters suffer from want of oxygen in the depth, and thus lead to erroneous results. In fact I have failed to find in Dr. Angus Smith's publications any mention whatsoever of cultivation on plates or their equivalents in any shape or form, which I hold to be the essence of the process which bears the name of Koch, and to which modern bacteriology is so profoundly indebted. Without, therefore, in any way wishing to detract from the interest attaching to Dr. Angus Smith's independent investigations on the application of gelatine to water examination, it appears to me that as he seems not to have been acquainted with what is known and described in text-books as Koch's method of water examination, he cannot obviously be said to have introduced it into this country. Indeed, I cannot personally find any more justification for the statement that Dr. Angus Smith practised Koch's method of gelatine-plate-culture in 1882, than there would be for saying that Hero drove a steam locomotive in Alexandria more than a century before the Christian era.

PERCY F. FRANKLAND.

Mason College, Birmingham, May 12.

On the Action of Röntgen Rays and Ultra-violet Light on Electric Sparks.

IN NATURE of April 30, the writer of "Recent Work with Röntgen Rays" has not exactly described the results of our experiments, published in the *Rendiconti dell' Accademia dei Lincei*.

We had formerly found that the sparking distance between two electrodes, in a shunt-circuit on the discharge of an induction coil, which illuminates a Crookes' tube, is strongly diminished if the Röntgen rays sent from the tube fall upon the positive electrode. The phenomenon is very interesting, as it is the reverse of the phenomenon discovered by Hertz, in which the ultra-violet light acts on the sparking distance in lengthening it, when falling on the negative pole.

On subsequent experiments, we found that when the sparking distance was the same as that used with Röntgen rays, the ultra-violet light acted exactly in the same way, and the passive pole —so to say—was then the positive one.

So far we had succeeded in reversing the phenomenon discovered by Hertz, and further investigated by Wiedemann, Ebert, Elster and Geitel, and had shown the parallelism of the two radiations as to their impeditive action on the spark.

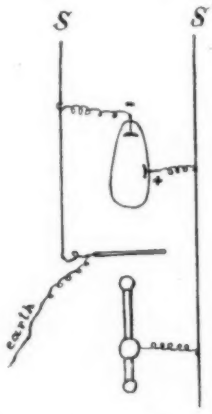
But on diminishing the sparking distance, when the ultra-violet light has a facilitating action, we have shown that the Röntgen rays would provoke the passing of the spark. In the last case the passive pole—*i.e.* on which the radiation must fall —is in both cases the negative.

So taking as electrodes two spheres of amalgamated brass, 52 mm. in diameter, when the sparking distance was below 30 mm., the Röntgen rays and the ultra-violet light provoke the passing of the spark when falling on the negative electrode. When, on the contrary, the distance was more than 30 mm., both radiations act in an impeditive way when falling on the positive pole.

This result is quite different to that referred to in the cited article, in which it is said that the simultaneous actions of the Röntgen rays and the ultra-violet light could be made to neutralise each other. From our experiments it follows, on the contrary, that the action of the two radiations is in every respect identical.

We will describe a method by which the action of the Röntgen rays on the spark is very clearly demonstrated.

s, s' are the terminals of the secondary of an induction coil. In front of the portion of the tube on which the kathode rays fall



s a thin aluminium plate 20 cm. square, in connection with the negative electrode of the Crookes' tube; whilst the positive is connected with a sphere so that the sparks between the plate and the sphere take place in the direction of propagation of the Röntgen rays, to which the aluminium plate is transparent. The plate is connected to the earth. With this apparatus the length of the spark can be made *four* times greater when the Röntgen rays are screened before falling on the aluminium plate. On diminishing the intensity of the current in the primary so as to conveniently shorten the sparking distance, the inverse phenomenon can be obtained, so that the spark does not pass when the Röntgen rays are screened.

Our present researches aim at the study of the alteration of the nature of the discharge when the spark is under the action of the Röntgen rays.

A. SELLA.
Q. MAJORANA.

Istituto fisico della Università di Roma, May 3.

Röntgen Ray Phenomena.

AT one of my demonstrations last week two tubes failed to act. They were both of the kind which depend for their action on a piece of platinum placed within, and from which after bombardment by kathode rays the Röntgen rays take origin. A glance at the tubes showed that owing to the unusual strength of spark the platinums within them were red-hot at the point of impact. Before the demonstration the tubes had been in good working order. I considered they had broken down, but, on returning home, tried them with the spark from my own apparatus, with which they had before answered well. I was somewhat astonished to find them giving off Röntgen rays rather more freely than when first tried. This tends to show that Röntgen rays are not given off by platinum heated above a certain temperature. I think this has already been suggested, but I have not seen it corroborated.

Following up the idea of reinforcing the effect of the Röntgen rays by placing a fluorescent screen under a sensitive film on celluloid, the celluloid side being next the screen to prevent "grain," and having tried screens of barium platino-cyanide, potassium platino-cyanide, calcium tungstate, natural scheelite, artificial scheelite (Edison's), fluor-spar and calcium fluoride, I find that potassium platino-cyanide and artificial scheelite alone produce any effect through celluloid. Barium platino-cyanide, placed underneath, gave no effect either in contact with the sensitive film itself or through celluloid, but the films were not sensitive to yellow, and this salt gives yellow fluorescence. The effect with potassium platino-cyanide was decidedly the best.

Chard, May 3. J. WILLIAM GIFFORD.

Alpenglühen.

AFTER the shadows of the lower mountains have swept up past the tops of the higher snow peaks, *i.e.* after the sun has set upon these last, and as the general light of the sky fades, the contrast between the illumination of the snow and of the sky usually increases. The westerly-facing snow peaks stand out against the darkened sky, and gradually change in tint. Very often the most noticeable change is to a clear greenish-white. But sometimes there is a period during which they have a faint rose or crimson glow. This is the true Alpenglühen; often confused by tourists with the ordinary rose-coloured illumination preceding the setting of the sun.

I see (NATURE, vol. liii. p. 588) that it has been suggested that this afterglow is due to what practically amounts to a second rising of the sun upon the high snow, owing to a peculiar arrangement of layers of hot and cold air in the atmosphere. This may be so; but it is rather a startling theory, and should be tested by observations from, say, the higher or lower observatories of Mont Blanc, simultaneously with observations of the Alpenglühen made from below anywhere to the west. A reappearance of the sun would be an interesting sight for the higher observer. In the meantime, my own observations of some twelve or thirteen summers would lead me to suggest the following explanation. In the first place, I do not think that the afterglow is nearly as vivid as an observer believes. To the eye, the stars "come out," and the moon becomes almost dazzling, as the general light of the sky fades; and both "fade" as day breaks.

Next, I noticed the following during five months of uninterrupted observations of sunsets in the plains of Argentina. On some fine evenings, there was left, as daylight faded, a vivid line or band (of uneven thickness) of intense crimson colour in the west. This was so strong and so well defined that it lit up the westerly face of the estancia with crimson, and actually threw a fairly sharp shadow of the horizontal gutter. Vertical poles, &c., had of course no shadow; the source was too long in a horizontal direction. This crimson streak did not appear always, by any means. The westerly sky itself often passed through various tints of a clear greenish-blue.

It seems to me that, considering the snow heights facing the

west, what has been pointed out concerning the fading of the rest of the sky, the comparative localisation of light and colour in the west, and the illusion as to brightness that occurs when the background fades, the phenomenon of Alpenglühen, and that of the greenish illumination so often seen, can be accounted for without the help of the startling hypothesis quoted.

But it would be more satisfactory if observations could be made from above. Would M. Vallot sacrifice himself and spend some nights up in the observatories that he directs?

R.N.E. College, Devonport. W. LARDEN.

The Positions of Retinal Images.

THE thanks of your psychological readers are due to Mrs. Ladd Franklin for having, in her letter published in your number of February 13, called attention to Schön's experiments, which, as she says, have been unaccountably overlooked. I have in consequence been repeating the experiment which Mrs. Franklin describes, but so far with purely negative results. Although some of the observers gave answers which might hastily have been interpreted as confirmations of Schön's illusion, a further analysis showed conclusively that no one on whom I have experimented, so far, perceived it.

Allow me to indicate one or two points in Mrs. Franklin's letter which seem to require elucidation. She writes as if the object looked at in the experiment "consists of a single bright point." But surely the point H in her diagram—the fixation point—was a bright point as well as O or O'? In Schön's experiments the apparent distance of O or O' was judged relatively to H (which was a stick of phosphorus), by the "stereoscopic (or pseudoscopic) effect," and his explanation of the illusion was that we (unconsciously) judge as if the image actually produced on the right retina had been produced on the left, and *vice versa*. The image on each retina consists of two bright points, but cannot strictly be called a "double image," since the bright points are produced by two distinct objects—by the phosphorus at H, and by the light proceeding from O' or O. If Schön's explanation is correct, then, supposing the light really proceeds from O', and when the ray O' r' is darkened appears to come from O, the observer ought to say the object appeared to be not merely as far off as H, but a *long way* behind it. Further, if the ray O' l' is darkened instead of O' r' there ought to be no illusion—he should say the object appears much nearer than H (*i.e.* still at O'); and if either ray is cut off altogether, he will have no reason for judging the object to be at O', but will probably judge it to be further back—where the source of light actually is. In my experiments, so far, none of the observers have made any distinction between cases where the ray O' r' was darkened and those where the ray O' l' was; but if either of them was darkened considerably, they answered just as they did when one of them was totally extinguished; judging the object to be about where the source of light actually was—which was about the same distance as the phosphorus mark H, and very much nearer than the point O would have been.

I hope to continue the experiments, if possible until I get a positive result, and should be glad therefore to hear some further details of Mrs. Franklin's experiments, especially with reference to the points I have brought forward, either privately or through your columns. EDWARD T. DIXON.

4 Cranmer Road, Cambridge, April 17.

Colour Variations in Ducks and Pigeons.

ABOUT a year ago you published a short article by Mr. Francis Galton (April 11, 1895, vol. li. p. 570), in which he urged the desirability of making careful records of all cases of "sports" or sudden variations in domesticated animals, &c. Two such sports having arisen recently under my own observation, one in ducks and one in pigeons, I write to place the facts before your readers.

(1) *Ducks.*—In January 1894, I bought in Beyrout market a drake of the common "Mallard" colours and four ducks, two of normal wild-duck colour, one pure white, and one black, splashed with white. From these ducks I raised, the same season, thirty-six ducklings; and, from eggs given by a friend, nine more. Concerning the latter, nothing need be said at present, except that their own mother was of a very dark, dingy brown, and the ducklings were nearly black in the down. Of the thirty-six ducklings hatched from my own ducks' eggs, twelve or thirteen (I neglected to note the exact number at the time) were different in colour from their olive-green brethren and from anything I had seen before, being of a beautiful pale fawn colour above, shading into canary-yellow beneath, with darker pencillings and shadings on the sides of the head and back, and with the normal, symmetrical series of three pairs of light marks on the upper surface, distributed just as in normal, olive-green ducklings. The entire set of these pale ducklings proved to be females, and their plumage, when adult, was a pretty yellowish or sandy-buff colour, with darker shadings, due to a brown streak down the middle of each of the contour-feathers. The speculum on the wing gave mostly sky-blue reflections, instead of the usual metallic green of common ducks. Two only of the dozen (or thirteen) differed perceptibly from the others, being of *uniform* cinnamon-brown colour, with white throats.

Five of these pale ducks were kept and allowed to breed, viz. one cinnamon-brown and four yellow ones. In addition, my stock during the season of 1895 consisted of three of the original old ducks (one white, one black, and one normal); three normal-coloured young ducks related to the pale ones (*i.e.* same paternity, and presumably same maternity to some extent); and two ducks raised from the eggs given by my friend, as above mentioned, and therefore non-related to the others—in all thirteen ducks. Of drakes there were four—two of normal mallard colour (related, as above, to the pale ducks), and two own brothers to the dark ducks, these having green heads and beautifully-pencilled stone-grey bodies, with no brown on the breast and no white collar—a departure from typical drake-colouration which is normal (in Syria at least) to dark varieties.

From this stock of ducks I raised last spring sixty-two ducklings, of which nineteen were fawn-coloured in the down. One of these died very young. Of the remainder, fourteen were females and four males. All were sandy-buff, none cinnamon-brown; but one—a female—was a shade or two darker than the rest, and when adult showed no metallic colours on the speculum, agreeing in this respect with the dark ducks of alien parentage.

Of greatest interest to me was the question: What will the "yellow" drakes be like when adult? Time has answered as follows: Head and neck, soft *coffee brown*, with obscure greenish reflections in some lights; narrow white collar; chestnut-brown breast, similar to mallard; upper tail-coverts (including curled feathers), and under-tail coverts, chocolate-brown; the rest delicate cream colour, with fine transverse pencillings on back and sides, similar to those on the mallard, but paler and less distinct: the whole effect very pleasing.

Of course all this may be familiar enough to some people, but it is quite new to me, and no mention of such drakes is made by Darwin in "Animals and Plants," nor by any other writer whose works I have been able to consult. Whether atavism has anything to do with the matter, I cannot say, as the parentage of my original stock is entirely unknown; but I am accustomed to notice very carefully all the ducks I see about town and the surrounding country, and am sure I have never come across any such during an experience of about twenty-five years. In any case, it is interesting to note that the new variety was far from being "swamped" by the inevitable crossing with its parent form.

(2) *Pigeons.*—In 1894 I procured a pair of birds of a variety known to Arab fanciers as black *Urjani* (or *Shamandarâni*). These are largish pigeons, wholly black, with two "red" (*i.e.* bright reddish brown) bars on each wing, corresponding to the black bars on normal "blue" pigeons. The pair were unrelated, the male coming from Hums, the female from Damascus. The variety is scarce in Beyrout, and is valued more or less by all Syrian fanciers, who breed it with some care; and it habitually breeds true. My birds produced during the season of 1895 ten young ones: six (3 ♂, 3 ♀) quite normal in colour; one (♀) slightly mottled on the shoulders with brown and a very little white; and three (all ♀), which in the nest plumage were uniform *light red*. (I had not a red bird in the loft—scarcely a red feather, aside from the red bars of the *Urjanis* themselves, so there was no question of illegitimate paternity.) But, strange to relate, when these red birds moulted, nine-tenths or more of their red feathers were replaced by *pure white*, so that their adult plumage may be described thus: *white* birds with red neck, abdomen red mottled with white, a very few red feathers scattered over back and shoulders; no trace of red bars.

Careful inquiry among Arab fanciers having personal experience of the breed in question, elicited the following

information. Black *Urjanis* usually breed true; when they fail to do so, the progeny is generally a sport of a particular kind called *dijji*, uniformly red when young, more or less mottled with white when adult. These *dijjis* are apt to "throw back," and in turn produce good *Urjanis*.

One of my own mottled birds (*dijji*) remains in my possession, and is now mated to an *Urjani*—an own brother. The pair has produced this spring four young: three *dijjis*, just like the mother, and one partial reversion to the *Urjani* form, being dark-chequered blue, with red bars on the wings. The original parent pair of *Urjanis* have also raised four squabs this season—three normal and one *dijji*; sexes not yet determined. I state these facts without comment; but would be glad to know whether fanciers in England or elsewhere have observed anything quite as striking in the way of colour-variation.

Beyrout, Syria. W. T. VAN DYCK.

Dependence of the Colour of Solutions on the Nature of the Solvent.

IT is a well-known fact that the colour exhibited by one and the same body in solution depends more or less on the nature of the solvent. In some cases this phenomenon can be satisfactorily accounted for by electrolytic dissociation, but in the majority of cases hitherto examined this explanation is not admissible. Perhaps the most striking of these is that of iodine, the solutions of which are coloured variously violet, blue, brown, and yellow. The hypothesis has been put forward that the variation in absorption might be due to the formation of molecular aggregates of variable complexity; but this, at least in the case of iodine, has been rendered very improbable by the recent researches of Beckmann and others. Nor does the hypothesis that the variation may be due to a varying degree of combination with the solvent seem much more promising.

If, now, absorption be a case of electrical resonance, should one not expect a relation between the absorption of the dissolved body and the physical properties of the solvent, sufficient to account for the observed variations? That such a relation should exist, seems possible from the following rough considerations.

The period of vibration of an electric oscillator is, in the usual notation,

$$T = 2\pi\sqrt{LC},$$

where L = self-induction, and C = capacity. But now:—

$$LC = g K\mu,$$

where g is a geometrical factor and K and μ are the dielectric constant and permeability of the surrounding medium. Also $n^2 = K\mu$, where n is the index of refraction of the medium for very long waves, whence it follows that

$$T = 2\pi n\sqrt{g},$$

which means that the principal absorption-band should travel towards the red end of the spectrum as the index of refraction of the solvent increases. This result is identical with the general qualitative law enunciated many years ago by Kundt, on the basis of experimental data. There are, it is true, various breaks in the parallelism; still this mode of viewing the question seems to offer more possibilities than the others.

Holywood, Belfast. F. G. DONNAN.

Hatching Lizards' Eggs.

CAN any of your readers suggest a way to hatch lizards' eggs? I have had a pair of bright-green lizards (I think they came from Italy) in a glass vivarium in a very sunny window for two years and a half. Last year, on May 19, the female laid eleven eggs. I left them exactly as the mother laid them, and after about three weeks I opened one and found the rudiments of a young lizard; but the other eggs never came to anything. I should like to rear them this year if it is possible. H. A. ROSS.

Trevean, Penzance.

THE DIFFUSION OF METALS.

IT is now quite usual to think of alloys as being solid solutions and to recognise that the atoms of solid metals are in active movement. That this must be the case, is revealed by the passage of metals to allotropic modifications in which the physical properties differ widely from those of the same metals in their normal state. It is well, therefore, that we should remember how much was done for us thirty years ago by Matthiessen in framing such views, and by Graham in showing that solid metals are true solvents for gases which move and diffuse freely in them, sometimes to reappear with gaseous elasticity.

The experimental portion of the latter work, Graham entrusted to me, and my hope that I should be able to extend his work on the diffusion of salts, to liquid and solid metals, has been somewhat tardily realised by the delivery in the present year of the "Bakerian Lecture" of the Royal Society, of which the following is a brief abstract.

PART I.—*Diffusion of Molten Metals.*

In the first part of it allusion is made to some earlier experiments of my own conducted in 1883 on the diffusion of gold, silver, and platinum in molten lead. It is strange that although the action of osmotic pressure in lowering the freezing point of metals has been carefully examined, very little attention has been devoted to the measurement, or even to the consideration, of the molecular movements which enable two or more metals to form a truly homogeneous fluid mass. The absence of direct experiments on the diffusion of molten metals is probably explained by the want of a sufficiently accurate method. Ostwald has stated, moreover, with reference to the diffusion of salts, that "to make accurate experiments in diffusion is one of the most difficult problems in practical physics," and the difficulties are obviously increased when molten metals diffusing into each other take the place of salts diffusing into water.

The continuation of the research was mainly due to the interest Lord Kelvin had always taken in the experiments. The want of a ready method for the measurement of comparatively high temperatures, which led to the abandonment of the earlier work, was overcome when the recording pyrometer was devised, and the use of thermo-junctions in connection with this instrument rendered it possible to measure and record the temperature at which diffusion occurred. Thermo-junctions were placed in three or more positions in either a bath of fluid metal or an oven carefully kept hotter at the top than at the bottom. In the bath or oven, tubes filled with lead were placed, and in this lead, gold, or a rich alloy of gold, or of the metal under examination, was allowed to diffuse upwards against gravity. The amount of metal diffusing in a given time was ascertained by allowing the lead in the tubes to solidify; the solid metal was then cut into sections, and the amount of metal in the respective sections determined by analysis.

The movement in linear diffusion is expressed, in accordance with Fick's law, by the differential equation

$$\frac{dv}{dt} = k\frac{d^2v}{dx^2}$$

In this equation x represents distance in the direction in which diffusion takes place, v is the degree of concentration of the diffusing metal, and t is the time; k is the diffusion constant, that is, the number which expresses the quantity of the metal in grams diffusing through unit area (1 sq. cm.) in unit time (one day) when unit difference of concentration (in grams per c.c.) is maintained between the two sides of a layer 1 cm. thick. The experiments described in the Bakerian Lecture showed that metals diffuse in one another just as salts do in water, and the results were ultimately calculated by the aid of tables prepared by Stefan for the calculation of Graham's experiments on the diffusion of salts, special tables being calculated by one of my students, Mr. A. Stansfield, in connection with this research.

The necessary precautions to be observed and the corrections to be made were described at length and the

values for k—the diffusivity of certain metals in lead, tin, bismuth and mercury, given in sq. cm. per day, are as follows :—

	k
Gold in lead	3·19 at 550°
,, bismuth	4·52 ,,
,, tin...	4·65 ,,
Silver in tin	4·14 ,,
Lead in tin	3·18 ,,
Rhodium in lead	3·04 ,,
Platinum in lead	1·69 at 490°
Gold in lead	3·03 ,,
Gold in mercury	0·72 at 11°

In order to afford a term of comparison, it may be stated that the diffusivity of chloride of sodium in water at 18° is 1·04.

It is at present too soon to draw any conclusion as to the evidence which the results afford respecting the molecular constitution of metals, but it is evident that they will be of value in this connection, because, with the exception of the gases, they present the simplest possible case which can occur—the diffusion of one element into another. Thus the relatively slow rate of diffusion of platinum as compared with gold, points to its having a more complex molecule than the latter.

It is very difficult within the limits of this brief abstract to show that molten metals actually pass into each other by diffusion. The following method will, however, serve to give a rough qualitative demonstration that such is the case. A white sheet of card, B, is, as Fig. 1 shows, mounted on a frame, and by means of the gearing C C′ can be raised or lowered at a definite rate, which can be maintained by the aid of a metronome. The diffusion cell is shown at A. It consists of a clay tube about 30 mm. long, heated from its upper part so that the top portion of the tube is hotter than the lower portion. This tube is filled with molten lead, and at the bottom of the lead, is a layer of a lead-gold alloy rich in gold. A sample of lead may be withdrawn from the tube at the beginning of a lecture and

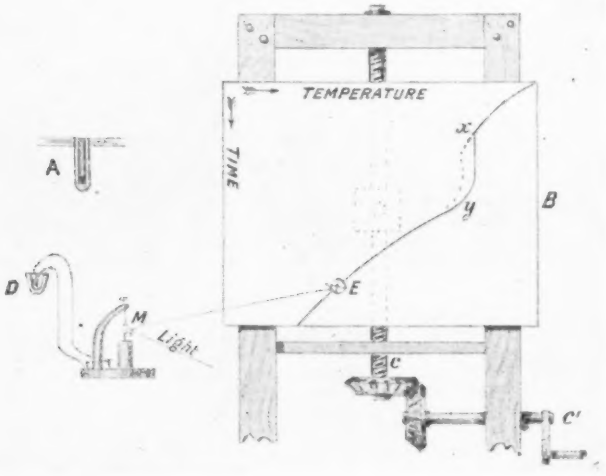


FIG 1

set aside, while a second sample of lead may be removed at the end of an hour, by which time gold will have diffused into the upper layers of lead, and consequently this second sample will be auriferous. Other experiments have shown that in this case convection currents do not complicate the result.

The proof that gold had diffused into lead can then be afforded by the fact that the point of solidification of the second portion of lead is, owing to the presence of gold in it, lower than that of the first portion, and this is shown to be the case in the following way. The first sample of lead is placed in a small crucible, D, and a

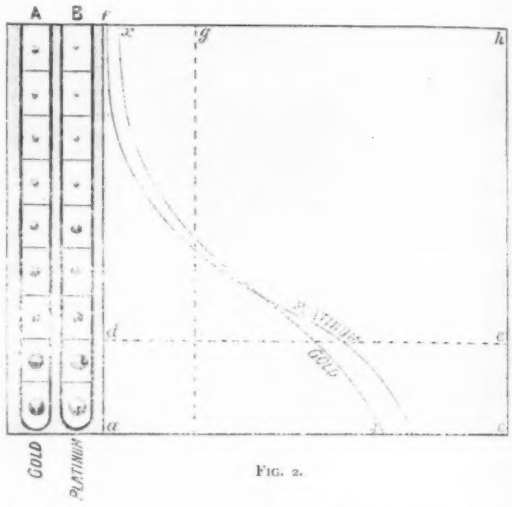


FIG. 2.

protected thermo-junction is immersed in the lead when it is fluid. The spot of light E from the mirror M, of the galvanometer connected with the thermo-junction is allowed to fall on the movable screen, and as the lead cools down the spot of light traverses the screen from right to left. The consecutive positions occupied by the centre of this spot of light are marked by hand with a stroke of charcoal. During the solidification of the metal the spot of light remains in one position, and consequently the portion of the curve which represents the solidification of the metal is the vertical line x, y. If the second sample of lead be treated in exactly the same way, and its "cooling curve" traced, it will be seen that the freezing point is lowered, and a demonstration is thus afforded that diffusion of gold has occurred in the lead contained in the tube A.

The results of the diffusion of platinum and gold in fluid lead during twenty-four hours is shown diagrammatically in Fig. 2. The lead was placed in tubes which were arranged side by side in the oven, to which reference has been made. The columns A B represent the actual length and diameter of the columns of fluid lead. The spheres, which are drawn to the left of the diagram, are slightly smaller than the buttons of gold and of platinum extracted from the several sections, shown by horizontal lines, into which the columns of lead were divided after the metal had been allowed to solidify. The curves represent the respective diffusivity of gold and of platinum. The vertical ordinate represents the *distance* in the direction in which diffusion takes place, and the horizontal ordinates *concentration* of the diffusing metal. Each of the metals gold and platinum which diffused into the fluid column of lead occupied in the form of an alloy rich in lead, the length $a\,d$, of the

tube, and in both cases, the initial concentration of the alloy, denoted by *a c*, from which diffusion proceeded, was the same, so that the area, *a c e d*, represents the total amount of gold or platinum employed in the experiment, the whole quantity of either metal being initially below the line *d e*. The final state of complete diffusion would be represented by the area *a b g f*, which is the same as *a c e d*, since the quantity of gold or of platinum remains unaltered. In the same manner the area *a y x f*, would represent the distributions of the gold at the end of the experiment, and consequently in experiments which have lasted for equal times, the nearer the curve approximates to the line *b*, *g*, the more rapid is the diffusion of the metal it represents. It will be evident from the distribution of the spheres of gold and platinum that diffusion can be accurately measured in molten metals.

PART II.—*Diffusion of Solid Metals.*

The second part of the investigation was devoted to the consideration of the diffusion of solid metals. Much of the evidence is historical, for there has long been a prevalent belief that diffusion can take place in solids, and the practice in conducting important industrial operations supports this view. In this connection two truly venerable "cementation" processes may be cited. The object in the first of these is the removal of silver from a solid gold-silver alloy, while the second is employed in steel making by the carburization of solid iron. In both of these processes, however, a gas may intervene, though the carburization of iron by the diamond, which, in 1889, I effected *in vacuo*, suggests that if a gas does intervene in the latter case, its quantity must be very minute. In connection with the mobility of various elements in iron the work of Colson, of Osmond, and of Moissan must be carefully kept in view.

The electro-deposition of metals also affords evidence of the interpenetration of metals. I observed in 1887 that an electro-deposit of iron on a clean copper plate will adhere so firmly to it that when the metals are severed by force, a copper film is actually stripped from the copper plate and remains on the iron, thus affording clear evidence of the interpenetration of metals at the ordinary temperature, and this interpenetration of copper and iron will take place through an intervening film of nickel.

My friend Dr. George Gore has given me the following interesting reference to the penetration of gold and platinum at a temperature below redness, which is recorded in "Weldon's Register" for July 1863 by Edward Sonstadt, who states that he gilded a platinum crucible "inside and out . . . but no sooner was the platinum warmed than it began to change colour, and before the crucible attained visible redness not a vestige of the gilding remained."

This is interesting in connection with the earlier observation of Faraday and Stodart, who in 1820 showed that platinum will alloy with steel at a temperature at which even the steel is not melted, and they expressed their interest in the formation of alloys by cementation, that is by the union of solid metals.

The remarkable view expressed by Graham, in 1863, that the "three conditions of matter (liquid, solid, and gaseous) probably always exist in every liquid or solid substance, but that one predominates over the other," affords ground for the anticipation that metals will diffuse into each other at temperatures far below their melting points. The important work by Spring, in 1886, on the lead-tin alloys, showed that they retain a certain amount of molecular activity after they become solid, and special importance will always be connected with the proof afforded by him (1882), that alloys may be formed either by the strong compression of the finely divided constituent metals at the ordinary temperature, or (1894) by the union of solid masses of metal compressed together at temperatures which varied from 180° in the case of lead and tin, to 400° in the case of copper and zinc; tin melting at 227° and zinc at 415°.

Early evidence as to the volatilisation of solid metals may be traced to the expression of Robert Boyle's belief, that even such solid bodies as glass and gold might respectively "have their little atmospheres, and might in time lose their weight," and Merget's experiment on the evaporation of frozen mercury is specially interesting in relation to Gay-Lussac's well-known discovery that the vapours emitted by ice and water both at 0° C., are of exactly equal tension. Demarçay's experiment on the volatilisation of metals *in vacuo* at comparatively low temperatures is, moreover, connected with the evidence afforded by Spring (1894), that the interpenetration of two metals at a temperature below the melting point of the more fusible of the two is preceded by volatilisation.

It is well to remember, however, that interesting as the results of the earlier experiments are, as affording evidence of molecular interpenetration, they do not, for the purpose of measuring diffusivity, come within the prevailing conditions in the ordinary diffusion of liquids, in which the diffusing substance is usually in the presence of a large excess of the solvent, a condition which was fully maintained in the experiments on the diffusion of liquid metals described in the first part of the Bakerian Lecture. Van 't Hoff has made it highly probable that the osmotic pressure of substances existing in a *solid solution* is analogous to that in liquid solutions, and obeys the same laws; and it is probable that the behaviour of a solid mixture, like that of a liquid mixture, would be greatly simplified if the solid solution were very dilute.

The experiments on the diffusion of solid metals are of the same nature as in the case of fluid metals, except that the gold, which was the metal chosen for examination, was placed at the bottom of a solid cylinder of lead instead of a fluid one.

In the first series of experiments, cylinders of lead, 70 mm. long, with either gold, or a rich alloy of gold and lead at their base, were maintained at a temperature of 251° (which is 75° below the melting point of lead) for thirty-one days. At the end of this period the solid lead was cut into sections, and the amount of gold which had diffused into each of them was determined in the usual way. Other experiments were made, in which the lead was maintained at 200°, and at various lower temperatures down to that of the laboratory. The following are the results in sq. cm. per day:—

				k
Diffusivity of gold in	fluid	lead at	550	... 3·19
,,	solid	,,	251	... 0·03
,,	,,	,,	200	... 0·007
,,	,,	,,	165	... 0·004
,,	,,	,,	100	... 0·00002

The experiments at the ordinary temperature are still in progress, but there is evidence that slow diffusion of gold in lead occurs at the ordinary temperature. If clean surfaces of lead and gold are held together *in vacuo* at a temperature of only 40° for four days, they will unite firmly, and can only be separated by the application of a load equal to one-third of the breaking strain of lead itself. The nature of welding, however, remains to be investigated, as there is probably interlocking of molecules and atoms, which precedes true diffusion. It may be considered remarkable that gold placed at the bottom of a cylinder of lead, 70 mm. long (which is to all appearance solid), will diffuse to the top in notable quantities at the end of three days. At 100° the diffusivity of gold in solid lead can readily be measured, though its diffusivity is only 1/100,000 of that in fluid lead at a temperature of 500°, and experiments which are still in progress show that the diffusivity of solid gold in solid silver, or copper, at 800° is of the same order as that of gold in solid lead at 100°.

I trust, therefore, that the experiments described in the Bakerian Lecture will show that the diffusion can readily be measured in solid metals, and that they will carry one step further the work of Graham.

W. C. ROBERTS-AUSTEN.

BOOKS ON BIRDS.[1]

THE issue of works on ornithology continues in an unbroken stream. There can be little doubt that since the arrangement of the birds in the National Museum in South Kensington, in their natural attitudes and surroundings, was adopted—a system largely followed in many of our provincial museums—there has been a distinct increase in the interest taken in natural history, and, as might be expected from the amount of knowledge as to their life and habits which these groups convey, the study of birds has largely increased. The constant demand for work after work on the limited subject of British birds is very remarkable, and is to some extent a measure of the growing interest in this branch of science.

With the second volume, which has lately appeared, Dr. R. Bowdler Sharpe has completed his "Handbook to the Birds of Great Britain" in Allen's Naturalist's Library, of which he is the editor. His knowledge of the subject of which he treats is admittedly unrivalled, while the thorough manner in which he performs all his work—though vast in amount—is so well known, that his name, as editor and author, is sufficient guarantee for the value and excellence of these two volumes. All that is essential to be known in the life-history of British birds is related shortly yet fully, in clear, popular language. This work forms a concise monograph of our native birds; indeed, no better or more authoritative work on the subject has yet been published. It is illustrated by numerous coloured full-page plates, the bulk of them the resuscitated drawings of Lizars from Jardine's Library. As has been often already pointed out, and pressed upon the attention of the publishers in regard to other volumes of this series, those plates are quite unworthy of the text. In the preface to the second volume the author replies to the critics who have attacked his method of nomenclature adopted in this and other volumes of the Library, the result of which is that certain species come to be designated by a duplication of their generic and specific names. Dr. Sharpe appears to us to have adopted the only logical course open to him, and his reply would seem to be unanswerable. "Thus if Linnæus," he says, "called the Partridge *Tetrao perdix*, the name *perdix* ought to be retained at all costs for the species. When *Perdix* was taken in a generic sense and the species was called *Perdix cinerea*, I contend that it ought never to have been allowed, and if in restoring the Linnæan specific name of *perdix*, it results that the oldest generic name is also *Perdix*, and the species has to be called *Perdix perdix* (L.), I can only say I am sorry, but it cannot be helped."

In Mr. Hudson's "British Birds" a brief account is given of the appearance, language and life-habits of all the birds that reside permanently or for a portion of each year within the limits of the British islands. The descriptive accounts of the various species are shorter, less technical and precise, but not less accurate than those in Dr. Sharpe's "Handbook." On the other hand, our author trusts that his work has the merit of simplicity, as it is intended for the general reader and, more especially, for the young. The species alone are described, the family and generic characters being omitted, as there was not space to make the book, "at the same time, a technical and a popular one." Like all that comes from Mr. Hudson's pen on this subject, the present volume is sympathetically and attractively written. It is illustrated by eight chromolithograph plates from original drawings by A. Thorburn, in addition to eight full-page plates and one hundred figures in black-and-white, from drawings by G. E. Lodge, prepared for this work, the whole of which are exquisitely reproduced. Altogether the book is to be very highly recommended. It is prefaced by a chapter on structure and classification by so competent an anatomist as Mr. F. E. Beddard, F.R.S. His contribution, however, though very clear and condensed, is, we fear, somewhat above the heads of the bulk of the young readers for whom Mr. Hudson's pages have been written. On p. 17, he remarks, with reference to the fore-limb in *Dinornis* that no trace of a wing has been so far discovered. In 1892 a scapulo-coracoid, with a distinct glenoid cavity, was figured in NATURE (vol. xlv. p. 257), indicating the presence of a humerus, which is surely at least a "trace" of a wing.

In the "Wild Fowl and Sea-Fowl of Great Britain," a "Son of the Marshes" depicts the haunts rather than the habits of the birds of our estuaries and fen-lands. His volume is more a collection of shooting sketches than a serious contribution to ornithology, notwithstanding the short technical descriptions, at the conclusion of each chapter, of the several species of the group to which the chapter is devoted. The author has given us during many years numerous delightful sketches of marsh-land life at every season, and under all conditions of sky and temperature; but we have had his message so often now, that it has begun to lose much of its freshness and flavour. In this latest delivery we cannot resist the impression that we have heard all he tells us before, and said even better than here. Many of his pages leave with the reader the irritating suspicion of having been elaborated with toil, and the matter beaten out to cover an allotted space. The numerous quotations from all sorts and conditions of marsh-folk, "coy" men, net-setters, and wild-fowlers, in which we fail, through obtuseness probably, to perceive anything humorous, quaint or original, might have been largely curtailed with advantage to the narrative. J. A. Owen, who edits the volume, has allowed to escape detection such unorthodox expressions as "to flight" and "flighting birds," as also the use of that most objectionable term "scientist," to indicate the professed man of science. The volume has numerous excellent full-page black-and-white illustrations by Bryan Hook.

[1] "A Handbook to the Birds of Great Britain." By R. Bowdler Sharpe, LL.D. Vol. i. 1894. Pp. xxii + 342. Vol. ii. 1895. Pp. xi + 308. (London: W. H. Allen and Co., Ltd.).

"British Birds." By W. H. Hudson, C.M.Z.S. With a Chapter on Structure and Classification, by Frank E. Beddard, F.R.S. Pp. xviii + 363. (London and New York: Longmans, Green, and Co., 1895.)

"The Wild-Fowl and Sea-Fowl of Great Britain." By a "Son of the Marshes." Edited by J. A. Owen. With Illustrations by Bryan Hook. Pp. 326. (London: Chapman and Hall, Ltd., 1895.)

"Birds from Moidart and Elsewhere; drawn from Nature." By Mrs. Hugh Blackburn. Pp. viii + 191. (Edinburgh: David Douglas, 1895.)

"The Birds of Berwickshire, with Remarks on their Local Distribution, Migration, and Habits, and also on the Folk-lore Proverbs, Popular Rhymes and Sayings connected with them. By George Muirhead, F.R.S.E. In two volumes. Vol. i. 1889. Pp. xxvi + 334. Vol. ii. 1895. Pp. xii + 390. (Edinburgh: David Douglas.)

"North American Shore Birds: a History of the Snipes, Sandpipers, Plovers, and their Allies." By Daniel Giraud Elliot, F.R.S.E. With seventy-four plates. Pp. viii + 268. (London: Suckling and Galloway. New York: Francis P. Harper, 1895.)

"The Birds of Ontario, being a Concise Account of every Species of Bird known to have been found in Ontario, with a description of their Nests and Eggs, and Instructions for Collecting Birds and Preparing and Preserving Skins, and Directions how to form a Collection of Eggs." By Thomas McIlwraith. 2nd edition. Pp. ix + 426. (London: T. Fisher Unwin; Toronto: William Briggs, 1894.)

"Birdcraft; a Field-book of Two Hundred Song, Game, and Water Birds." By Mabel Osgood Wright. With full-page plates. Pp. xvi + 317. (New York and London: Macmillan and Co., 1895.)

"Photographs of the Life-History Groups of Birds in the Grosvenor Museum, Chester." Prepared by Mr. R. Newstead, Curator; photographed by G. W. Webster. 1895.

"The Royal Natural History." Edited by Richard Lydekker, B.A., F.R.S. Vol. iv. Birds (chaps. viii.-xxi.). Pp. xv + 583. (London: Frederick Warne and Co., 1895.)

"The Fauna of British India, including Ceylon and Burma." Published der the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. Birds. Vol. iii. By W. T. Blanford, F.R.S. p. xiv + 450. (London: Taylor and Francis; Calcutta and Bombay: hacker and Co.; Berlin: Friedländer, 1895.)

We next come to notice two local faunas. The first of which is Mrs. Hugh Blackburn's "Birds from Moidart and Elsewhere." The authoress is a well-known artist, and the volume before us is not so much a systematic avi-fauna of the region in which she resides, as a series of drawings from nature, all of them artistic, vigorous, and true to life, of such birds as she has known personally, "to which are added," as she tells us in the preface, "simply, and I trust truthfully, a few observations which I have had the opportunity of making on their life and habits." Her sketch of the young and callow cuckoo ejecting the rightful meadow pipits from their nest, is the original illustration of this most interesting fact, which, first made known by Henry Jenner in 1788, and long rejected as apocryphal, was in 1871 re-described, and still more fully established in 1872, when it was sketched from actual observation by Mrs. Hugh Blackburn. Her plates illustrating the habits of many species not to be observed everywhere, such as "Solan-geese fishing," "Cormorants feeding their young," "Osprey carrying a fish," are of real scientific interest and value. So also are the sketches of the nestlings of several birds whose breeding-places are chosen in out-of-the-way corners, whither our artist seems to have followed them. Mrs. Blackburn states the interesting facts that in 1856 there were no starlings in Moidart, where they are now plentiful, and not for many years after were there any common sparrows. On the advent of the latter, however, the yellow-hammers, "which used to be very common," began to decrease rapidly. She records also, on the faith of a correspondent, that a nightingale was heard for three weeks, and also seen during the month of June 1889, "at Achnacary," which, if the observation can be depended on, is a far cry beyond its usual northern limit. On turning to Dr. Sharpe's and Mr. Hudson's volumes, noticed above, we find it recorded that in Scotland and Ireland the nightingale is unknown. (!)

"The Birds of Berwickshire," by Mr. George Muirhead, of which the first volume was published in 1889, and the second in 1895, contains a full account of every bird known to occur in that extensive shire. The work, published by David Douglas, of Edinburgh, is printed on special paper, and on its pages space and variety of type have been generously lavished. Each bird's history is concluded by a charming pen-and-ink etching of its nest, of one of its favourite haunts, or of some interesting, historical, or beautiful Berwickshire "bit," which has more or less direct reference to the subject of the chapter. There are, in addition, several full-page etchings by Scottish Academicians, and an excellent map of the county. Altogether, therefore, no expense has been spared (as is wont with the publishing house of David Douglas) to produce a work worthy of its predecessors in their sumptuous Natural History Library. And although these volumes can but record few new facts about the birds described in them except what is of local distributional interest, they are full of folk-lore, proverbs, popular rhymes and sayings about them, which must ensure the book being greedily desired as a prized addition to his volumes *de luxe*, not only by every lover of birds and their haunts, but by all who treasure dainty books.

The three volumes next on our list follow much the same lines as those above noticed, only they deal with American instead of British birds. "North American Shore Birds," by D. G. Elliott, who is well known by his numerous magnificent scientific monographs, "is a popular work and in no sense a scientific treatise," as the preface informs us. Its object is to enable the sportsman and those who love to study birds in their haunts, to know and recognise those they shoot or observe on the wing. "The accounts of their habits have been written, to the best of the author's ability, in anguage 'understanded of the people.'" Mr. Elliott will, we have no doubt, be fully successful in his object, for his book cannot fail to satisfy both those classes; and we are confident it will be their frequent companion, both "in the open" and in the study. The volume is not a mere compilation, for the record of the habits of most of the species are derived from the author's own experience in the many hunting excursions he has undertaken from arctic Alaska all over the North-American continent, and as far south as Rio de Janeiro. Nearly every species described in the book is illustrated by a full-page plate in black-and-white from drawings of great beauty by Edwin Sheppard, of the Academy of Sciences of Philadelphia, "an artist possessing exceptional talent for portraying birds and bird-life."

Mr. McIlwraith, in his "Birds of Ontario," enumerates 317 species, which he believes to be the complete tale of the birds occurring in the province of his domicile. A short, but sufficient, account is given of their plumage, their range, their distribution in Ontario, and, as they are nearly all migatory, of where they spend the breeding season, as well as of their nests and eggs. In the introduction full instructions are provided for the young collector how to obtain and preserve his specimens.

In "Birdcraft," Mabel Osgood Wright describes and illustrates two hundred song, game, and water birds of North America. Her book is written for the young, in whom she wishes to encourage the study of "the living bird in his love songs, his house-building instincts, and his migrations," to discourage in them the "greed of possession" of the skin, nest and eggs of her feathered friends, and to enable them to identify and properly name the species they may observe in their excursions. To her disciples—may they be many!—she gives this excellent advice: "Take with you three things, a keen eye, a quick ear, and loving patience"; but leave to "the practised hand of science," "the gun that silences the bird-voice, and the looting of nests." The authoress, who is herself, apparently, a keen and sympathetic observer of nature, believes that all the lover of birds wishes to know of their forms closer at hand, on his return from the field, should be sought for, and will be found, in those "great picture-books"—the museums. "Birdcraft" should form an excellent guide to the young American field-naturalist. Unfortunately the chromo-lithograph plates, on which eight to ten species, varying greatly in colour and size, are crowded, leave much to be desired. A "key to the birds" is provided at the end of the book, by which (*a*) land birds, (*b*) birds of prey, and (*c*) game, shore and water birds may be identified by their predominant colours.

The "Life-History Groups of Birds" in the Grosvenor Museum, Chester, most of which have been mounted by the Curator, Mr. Newstead, have been photographed "in life-like attitudes" with the "natural surroundings proper to the particular specimens," by Mr. G. W. Webster of the same city, and offered to the public in a handsome volume. It is hoped by the authors that these pictures "will appeal to curators and museum authorities, to all lovers of birds and nature, and to artists." To curators of museums they may on occasion afford suggestions; but as they are a class who strongly object to imitate slavishly the methods of even the greatest of their colleagues, they will probably prefer to seek inspiration from the same source as Mr. Newstead. To artists and lovers of birds we have no doubt these platinotypes will afford a great deal of pleasure, and in the case of the former they will be extremely useful as models. The weight of the volume and its high price (necessary from the costliness of its get-up) will, however, we fear, militate against a wide circulation, and certainly against its use for frequent and comfortable reference.

The fourth volume of the "Royal Natural History," edited by R. Lydekker, F.R.S., completes the account of

the birds. The contributors on this occasion are Dr. Bowdler Sharpe, Mr. Ogilvie-Grant, and the editor, whose names are sufficient sponsors that the present volume is in no way behind its predecessors, which every section of the press has been unanimous in praising on account of the scientific excellence of the text, and the beauty of the illustrations. As a "Natural History," presenting a popular and comprehensive survey of the subject, the "Royal" is unsurpassed.

The now well-known two first volumes of the "Birds" in the valuable "Fauna of British India," which the India Office has been so well advised in publishing, were written by Mr. Oates. The present volume has been prepared by the editor of the series, Dr. W. T. Blanford, "who," as he says, "has endeavoured to keep the [continuation of the] work uniform in general plan, and to render the change in authorship as little conspicuous as possible." Everywhere throughout the book, the same care and pains that were manifest in Mr. Oates' two volumes are evident in the third before us. Thanks to Hume—the value or extent of whose unsurpassed gift to the nation has yet hardly begun to be appreciated as it must one day be—never before has material for an avi-fauna of India, approaching in its richness been anywhere brought together as that now conserved in the British Museum. The amount of comparison and original investigation demanded, consequently, of the authors in compiling for the first time since this collection has been available, the bird-fauna of our Eastern empire, has been enormously extended, as well as facilitated. Although Mr. Oates, on being prevented from completing the work he commenced, by his recall to official duty in India, handed over to Dr. Blanford, on his departure, the notes he had prepared for its continuation (which have been "of very great service," as the author admits), yet the more arduous part of the work had still to be done. That this task, slow, full of drudgery, and testing all the penetration and discrimination of the ornithologist, has been most conscientiously fulfilled, is evident on every page, and with a result in all respects on which Dr. Blanford is to be congratulated.

It had been intended to complete the "Birds" and (with that section) the Vertebrata of India with the present volume; but as the work progressed, it "became evident that the proposed third volume would be of inconvenient size," and it was, therefore, decided to divide it into the present and a concluding volume, which, it is stated, is now in an advanced state of preparation. The volume under notice includes the *Eurylæmi*, *Pici*, *Zygodactyli*, *Anisodactyli*, *Macrochires*, *Coccyges*, *Psittaci*, *Striges*, and *Accipitres*. The different orders are distinguished chiefly by their anatomical characters. The *Striges* are rightly kept distinct from the *Accipitres;* but the *Pandionidæ* are included within its limits. We should rather have seen them constituted a distinct order, *Pandiones*. It is with satisfaction we note that the publication of the final volume will not be long delayed.

NOTES.

THE long list of birthday honours contains the names of a few men distinguished for their scientific attainments. Prof. Max Müller is to be sworn of the Privy Council. Mr. Clements R. Markham, C.B., F.R.S., the President of the Royal Geographical Society, is promoted to be K.C.B., and Dr. David Gill, F.R.S., Astronomer Royal at the Cape, is made a C.B. Dr. J. G. Fitch, who until lately was Chief Inspector in the Education Department, and Mr. Le Page Renouf, the Egyptologist, have been knighted.

THE Chemical Society's Lothar Meyer Memorial Lecture will be delivered by Prof. P. P. Bedson, at an extra meeting of the Society on Thursday, May 28.

THE Cracow Academy of Sciences has appointed Prof. L. Natanson as its representative at the forthcoming Kelvin celebration at Glasgow.

THE Council of the Sanitary Institute have accepted an invitation from the city and county of Newcastle-upon-Tyne to hold a Sanitary Congress and Health Exhibition in that city in the autumn of this year.

PROF. ANGELO HEILPRIN has been appointed to represent the Academy of Natural Sciences of Philadelphia at the Mining and Geologica Millennial Congress, to be held at Budapest, September 25 and 26, in connection with the celebration of the founding of the kingdom of Hungary. Messrs. Persifor Frazer, Angelo Heilprin, Benjamin Smith Lyman, and Theodore D. Rand have been appointed by the Academy as the Committee on the Hayden Memorial Geological Award for 1896.

ON the occasion of the Hungarian Millennium, the Emperor Francis Joseph has authorised the Budapest University to confer the following honorary degrees:—On Prof. Henry Sidgwick, of Cambridge, the honorary degree of Doctor of Political Economy; on Prof. J. S. Billings, of Philadelphia, and on Sir Joseph Lister the honorary degree of Doctor of Medicine; on Mr. Bryce, M.P., Mr. Herbert Spencer, Lord Kelvin, and Prof. Max Müller, the honorary degree of Doctor of Philosophy.

THE conversazione of the Society of Arts will be held at the South Kensington Museum on Wednesday, June 17.

PROF. E. SUESS, the well-known geologist, and Liberal politician, has just retired from his party in the Austrian Parliament.

THE death is announced of Prof. Germain Sée, the distinguished French pathologist, and member of the Paris Academy of Medicine.

A CONVERSAZIONE of the Society for the Protection of Birds will be held at the Royal Institute of Painters in Water Colours, Piccadilly, to-morrow evening.

WE learn, from the *Journal de Botanique*, that M. L. Diguet has been commissioned by the Minister of Public Instruction for France, and by the Museum of Natural History, with a botanical mission to Lower California, where he will probably make a prolonged stay.

MR. MARK JUDGE, Honorary Secretary to the Sunday Society, sends us the following statement of attendances on Sunday last at the great national museums in London:—South Kensington Museum, 2659; Bethnal Green Museum, 799; Geological Museum, 212; British Museum, 1790; Natural History Museum, 2398; National Gallery, 2106. The total is 9864, which number of visitors may be taken to justify the continuance of the Sunday opening of the museums.

THE Croonian Lectures of the Royal College of Physicians will be delivered on June 2, 4, 9 and 11, by Dr. George Oliver, who will take for his subject "The Study of the Blood and the Circulation."

ON Tuesday next, May 26, Prof. T. G. Bonney, F.R.S., will begin a course of two lectures, at the Royal Institution, on the "Building and Sculpture of Western Europe" (the Tyndall Lectures). On Thursday (May 28) Dr. Robert Munro will deliver the first of two lectures on "Lake Dwellings," and on Saturday (May 30) Dr. E. A. Wallis Budge, Keeper of the Egyptian and Assyrian Antiquities, British Museum, will begin a course of two lectures on the "Moral and Religious Literature of Ancient Egypt." The Friday evening discourse on June 5 will be on "Electrical and Magnetic Research at Low Temperatures," the lecturer being Prof. J. A. Fleming, F.R.S.

A SEVERE storm is reported by Reuter to have swept over Sherman, Texas, on Friday afternoon, completely destroying the western portion of the town. It is estimated that 120 persons, a large proportion of whom were negroes, were killed, and that 100 were injured. The storm, which travelled in a northerly direction over a path of 400 yards wide, swept everything before it. A waterspout burst at the same time over Howe, Texas, where eight persons were killed and many injured.

THE Swedish Tourists' Club has organised an expedition to the Great Lake Falls next August. The object of the expedition is to give those who join it an opportunity of seeing the total eclipse of the sun on August 9, of becoming acquainted with Lapland, and at the same time to see two of the finest waterfalls in Europe—the Great Lake Falls (Stora Sjöfallet) and Harsprånget. The party will start from Gellivare on August 3. Further information with reference to the journey can be obtained at the Tourists' Club, No. 28 Fredsgaten, Stockholm.

PROF. S. P. LANGLEY, who has for some time devoted attention to the problem of artificial flight, appears to have attained a remarkable degree of success. The New York correspondent of the *Daily Chronicle* reports that trials made with Prof. Langley's "aërodrome" have clearly demonstrated the efficiency and practicability of the invention. It is stated that "two upward ascents of about half a mile were made at a speed of twenty miles an hour. The machine in motion suggests a huge bird, soaring in large curves. When the steam gave out, the aërodrome sank gracefully and was picked up undamaged. No passengers were carried in the trial trips."

WITH reference to the reported dispatch of an American Antarctic Expedition under Dr. Cook, which was referred to in NATURE last week, we observe in the new number of the quarterly *Bulletin* of the American Geographical Society, New York, that the report is entirely incorrect, and that there does not appear to be "any immediate prospect of the launching of such an enterprise." The Belgian expedition, on the other hand, seems to be in course of rapid organisation; but it does not appear that the necessary funds have yet been completely subscribed. It will be under the command of Lieut. de Gerlache, of the Belgian Navy, and M. Arctowski will have charge of the oceanographical work to be carried out on board.

THE second annual meeting of the Botanical Society of America will be held in Buffalo, N.Y., on Friday and Saturday, August 21 and 22, 1896. Dr. William Trelease, Director of the Missouri Botanical Garden, will retire from the presidency, and will be succeeded by the President-elect, Dr. Charles E. Bessey, Professor of Botany in the University of Nebraska. At the evening session on Friday, August 21, the retiring President will deliver a public address on "Botanical Opportunity." The Botanical Society of America is affiliated with the American Association for the Advancement of Science, the sessions of which this year begin on Monday, August 24, in Buffalo.

THE Batavian Society of Experimental Philosophy at Rotterdam has offered prizes for the following botanical subjects:—The anatomical and chemical composition and vital functions of one or more at present undescribed species of plant natives of Holland or of the Dutch colonies; description of the vital conditions and properties of a mould-fungus, ferment, or bacterium of technical importance; new investigations on the action of flowers of sulphur or of copper salts on a pathogenous parasite; investigations on the presence, formation, and properties of the latex in the leaves of the caoutchouc-plant. For each subject a medal worth thirty duc. is offered; the work must be hitherto unpublished, and may be written in Dutch, German, French, or English. The essays must be sent, before February 1, 1897, with a motto, and the name in an enclosed envelope, to Dr. G. J. W. Bremer, Secretary to the Society, Rotterdam.

THE Ottawa correspondent of the *Times*, writing under date May 19, says: "The Royal Society of Canada, representing all the scientific and learned societies in the Dominion, met to-day. The business transacted included the adoption of a memorial to the Governor-General on the subject of the sixth resolution of the Prime Meridian International Conference of 1884, praying his Excellency's intervention with the home authorities with respect to the unification of nautical, civil, and astronomical time. Evidence was submitted establishing the fact that ship masters, both British and foreign, are almost unanimously in favour of the proposal, and that Canada, not only as a maritime portion of the Empire, but in other respects also, is peculiarly interested in the matter. It is strongly urged that the reform should be adopted so as to come into effect on the first day of the new century, and that, as nautical almanacs are prepared some years in advance, no time should be lost in adapting them to the change."

THE Paris correspondent of the *Chemist and Druggist* remarks that there are several pictures of interest to men of science at the Salon of the Champs Elysées this year. The most attractive of these is a decorative panel by Fournier, ordered by the State for the purpose of being placed in Pasteur's old laboratory at the École Normale Supérieure. The centre figure of the panel is an excellent portrait of Pasteur, who is depicted working by gaslight at a table in his laboratory, and the light is made to illuminate his fine features. Before him is a microscope, and he is shown in a reflective attitude as though about to make an entry in an open book that lies before him. Immediately above him is the figure of a woman personifying Science, receiving another, representing suffering humanity, in her arms. On the left are two young doctors in the act of inoculating a patient. On the right is a group of women, one holding forward her baby. A number of appropriate inscriptions appear on the panel.

THE *Weekly Weather Report* of the 16th inst. shows that the rainfall of the British Islands since the beginning of the year is deficient in all districts except the north of Scotland. The greatest deficiency is in the Channel Islands, where it amounts to 6·3 inches; in the south-west of England it amounts to 5·7 inches, and in the south of England to 4·5 inches. The severity of the recent drought may be judged by the following low falls in hundredths of an inch between April 17 and May 17, inclusive, in various districts:—Scarborough, 18; Spurn Head, 14; Cambridge, 17; Rothamsted, 8; Loughborough, 7; Oxford 0; London, 4; Dungeness, 10; Holyhead, 15; Prawle Point, 5; Donaghadee, 18; Roche's Point, 11; Scilly, 5. The general distribution of barometric pressure over our Islands during the drought has been anticyclonic, with light or moderate north-easterly and easterly winds; while areas of low pressure occasionally passed over the north of Scotland, and occasioned slight falls of rain in the north and west. On the 18th inst., however, a well-marked "V-shaped" depression passed across the northern parts of our Islands, causing rain at many stations, and amounting to half an inch in parts of Scotland.

THE rule followed by Irishmen at Donnybrook fair, to hit a head whenever they saw one, seems now to be applied to meteorological instruments. Writing from Edinburgh, Mr. W.

Black says a friend of his recently had his meteorological instruments upset and kicked about by Irish miners working in Lanarkshire. But the exuberance of spirits which led to this destruction is not confined to Irishmen, for Mr. Black says that at Duddingston Loch, some time ago, a number of Bank Holiday savages upset a complete meteorological equipment into the water near which it was installed; while in several northern towns it is necessary to enclose the instruments in iron cages to preserve them from being used as targets by the demon boy. Probably much of the destruction is the result of sheer wantonness, but anthropologists might be able to find evidence that the instruments are considered uncanny, in which case we should have to confess to the survival of the mediæval superstition against meteorology.

MOST workers with Röntgen rays have observed that a photographic plate becomes more or less fluorescent when the rays fall upon it. Mr. W. J. D. Walker informs us that a Paget x x x x x plate used by him fluorised so decidedly, that it made a very fair fluorescent screen, capable of showing coins in a purse, the bones of the fingers, screws and nails in a wooden block, and similar objects.

A NUMBER of excellent Röntgen photographs received from Mr. H. S. Pyne, of King William's College, Isle of Man, show that the Wimshurst machine is capable of producing effects comparable with those given by means of a good induction coil. The machine employed had plates fifteen inches in diameter, and the best results were obtained when the discharge was made intermittent. By this means the tube is rested, and, even with a quarter of an hour's continuous work, the phosphorescent area does not become appreciably warm. A Newton's "focus" tube was used, and the definition of the pictures produced by its radiations is exceedingly good and sharp. All the plates used were "Ilford rapid," with the exception of one, being a "Cadett" lightning. The latter plates Mr. Pyne has found to require the least exposure.

THE peculiar glow exhibited by a "focus" tube working well furnishes a good criterion of efficiency as regards Röntgen rays. A more definite means of comparing the actinic power of the radiation has been produced by Messrs. Reynolds and Branson, Leeds. A small quadrant of aluminium is constructed in concentric terraces, ranging from one millimetre to ten millimetres in thickness. By holding this quadrant between an excited Crookes' tube and a phosphorescent screen, the thickness of aluminium which the rays are capable of traversing can be seen upon the screen; or, by substituting a sensitive plate for the screen, the effect may be photographed. The "X-ray meter," as the quadrant is called, thus furnishes an easy means of comparing the intensity of Röntgen rays emitted by different tubes and by the same tubes at different times.

FROM Prof. A. Battelli and Dr. A. Garbasso, of Pisa, we have received several interesting papers describing their experiments on Röntgen rays. Referring to the discovery that the time of exposure required for taking photographs with these rays can be greatly shortened by placing certain fluorescent substances behind the photographic plate, the authors point out that they described a method of doing this in the January number of *Il Nuovo Cimento*. In some cases Prof. Battelli and Dr. Garbasso obtained good photographs with an exposure of only two seconds. In their paper, experiments were also described proving that Röntgen rays can be reflected (or at any rate scattered) from surfaces, but indicating an absence of refraction. Since the appearance of the above paper, Prof. Battelli has communicated two further papers to the same journal. In the first, the author arrives at the conclusion that Röntgen rays behave as if they emanate from the base of the vacuum tube rather than from the anode or kathode, also that they are emitted even after the discharge in the tube has ceased (as proved by the discharge of an electrified disc in the neighbourhood of the tube). In the second paper, Prof. Battelli deduces that the rays which emanate from the kathode in a vacuum tube possess photographic properties; that their action increases as the rarefaction increases (at least up to $\frac{1}{200}$ mm. of pressure); and that some of the rays are deflected by a magnet, while others are not. It is hence quite permissible to maintain that Röntgen rays exist in the interior of the tube. This view does not contradict the result that the rays *appear* to have their origin at the point where kathodic rays meet with an obstacle. It is easily seen that such an obstacle would act on the rays either as a filter or by scattering them in all directions.

THE various manurial trials conducted on behalf of the County Councils of Cumberland, Durham, and Northumberland in 1895, form the subject of a report by Prof. Somerville, of the Durham College of Science. Results of experiments on turnips, conducted at twelve centres, are considered to give a definite answer to the question as to whether it is the potash, the magnesia, or the salt in kainit that determines its value, its efficacy being attributed to the potash, which is the only substance that has consistently increased the average crop in these trials. No point has been more clearly demonstrated in the field trials of the last few years than that large dressings of dung or artificial manures do not increase the turnip crop to the extent usually supposed. It is argued that they would be more effective if they were applied in small quantities to each crop in the rotation as it came to occupy the land, instead of being, as at present, put into the land, say, every four years, to be exposed to all the wasteful agencies that may operate upon them till the plant food that they contain is exhausted. Manurial reform would seem to be most needed in the case of the artificial manures, since, for the incorporation of dung with the soil, the root-break offers facilities such as are afforded by no other crop in the rotation. The report includes details of experiments with finger-and-toe in turnips, and with *bouillie bordelaise* as a check upon potato disease.

THE report of the field experiments carried out in 1895 by the Agricultural Department of the University College of North Wales, Bangor, under the auspices of the County Councils of Anglesey, Carnarvon, Denbigh, Flint, and Montgomery, forms a brochure of some fifty pages. The experiments were concerned with the manuring of swedes, of pasture land, and of hay fields, the growth of oats from different quantities of seed, and the effects of various manures on the growth of vegetables. The work was conducted at more than thirty distinct centres, scattered over the five counties, and the question arises as to whether this is not too diffuse an application of energy to afford the best results. It is stated that within the last eleven years the trials "have gone on increasing until the number of centres has almost reached forty." Some of these places are nearly 150 miles apart, and many are far removed from railways. It is, however, correctly understood that these field trials are really intended to serve the purpose of object-lessons, "in which conclusions arrived at elsewhere may be made use of for the benefit of particular districts." There is considerable variation in the results obtained from the use of the same manures when applied to hay and pasture lands in different parts of North Wales. Phosphatic manures have proved the most satisfactory, and of these the most economical manure in the majority of cases was basic slag. The experiments, which must have involved a large amount of work, were conducted by Messrs. T. Winter, Bryner Jones, R. H. Evans, and F. V. Dutton. Every care should be taken to secure exactitude in such reports as this, intended for circulation amongst farmers

We notice that no denomination is given to the weights of seeds in the table on p. 47, though pounds, of course, are intended.

MESSRS. MACMILLAN AND CO. have made arrangements for the issue in New York and London of a "Dictionary of Philosophy and Psychology," under the editorial supervision of Professor Baldwin of Princeton University. All the matter in the Dictionary will be original and signed, and the several departments will be entrusted to men most competent to deal with them.

WRITING with reference to the diagram published in NATURE of February 27 (vol. liii. p. 404), to illustrate the movements of the terrestrial pole determined by Prof. Albrech, Mr. T. W. Kingsmill points out that the irregular variations in the curve are apparently coincident with remarkable seismic disturbances. He therefore suggests that there is a connection between movements of the earth's axis and unusual seismic activity.

WE have received two more of the valuable publications of the Geological Survey of Canada, forming Parts B and M of Annual Report, vol. vii. The first of these is a Report on the Kamloops map-sheet of British Columbia, by Dr. G. M. Dawson. It is accompanied by two maps of the area, one strictly geological, the other glacial and economic, and the Report itself contains a number of reproductions of photographs of the district. The rocks of the area range from Cambrian to Tertiary and later, and are described at length; while topographical, meteorological, and mineralogical observations are also recorded. The whole volume consists of over 400 pages. The second is a Report by Mr. R. Chalmers on the surface geology of parts of New Brunswick, Nova Scotia, and Prince Edward Island. Besides minor matters of local interest, it includes discussions on the origin of the Bay of Fundy depression, the glacial striæ of the district, and the destruction of the forests. Several maps accompany the Report, and a photograph of the famous tidal bore in the Petitcodiac River, Bay of Fundy, deserves special mention.

TRUE it is that at the Royal Victoria Hall, in Waterloo Bridge Road, music and mummery occupy a larger share of attention than lectures on scientific subjects. South London audiences have but a mere *penchant* for the generous new wine of science; they reserve their capacities for the variety entertainments. But though the audiences on Tuesday evenings, when scientific discourses are delivered, are very much smaller than on the evenings when a lighter vein predominates, they listen in a way which shows that they appreciate the fare provided for them. And it is satisfactory to know that most of the lecturers are in the front rank of scientific investigators, for this fact may be taken as a guarantee that sound information is imparted. The list of lecturers and subjects given in the report on the work of the Hall during 1895 is most creditable to the energy of Miss Cons, the Secretary, and to the generous spirit of the men of science who gave their services.

FOLLOWING up the work which resulted in the preparation of the phosphoryl chlorobromides, M. Besson (*Comptes rendus*, May 11), by a similar method, has succeeded in preparing the corresponding thiophosphoryl derivatives. A mixture of hydrobromic acid and thiophosphoryl chloride passed over pumice at 400°–500° C. yields a liquid from which it is possible, by fractional distillation under reduced pressure (60 mm.), to separate both the intermediate chlorobromides. These substances resemble in their general behaviour the corresponding phosphoryl compounds. They undergo partial decomposition when distilled under ordinary atmospheric pressure, and are slowly acted upon by water. The chloromonobromide, ($PSCl_2Br$), has been previously obtained by Michaelis by the action of bromine upon $PSCl_2(OC_2H_5)$, but his product seems to have been impure.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by Mr. F. Greswolde-Williams; a Red-fronted Lemur (*Lemur rufifrons*, ♂) from Madagascar, presented by Mr. E. A. Pardoe; a Grison (*Galictis vittata*), a Black Tortoise (*Testudo carbonaria*), a Brazilian Tortoise (*Testudo tabulata*), a Rough Terrapin (*Clemmys punctularia*), two Scorpion Mud Terrapins (*Cinosternon scorpioides*) from South America, presented by Mr. J. J. Quelch; a Lesser Kestrel (*Tinnunculus cenchris*), captured off the coast of Sicily, presented by Mr. J. L. Spaull; a Natal Python (*Python sebæ*, var. *natalensis*), a Ring-hals Snake (*Sepedon hæmachetes*) from South Africa, presented by Mr. W. Champion; a Common Viper (*Vipera berus*), British, presented by Mr. H. L. C. Barret; eight Esquimaux Dogs (*Canis familiaris*), Arctic Regions, deposited; a Pied Crow Shrike (*Strepera graculina*) from Australia, two Whooper Swans (*Cygnus musicus*), European, purchased; two Barbary Wild Sheep (*Ovis tragelaphus*), born in the Gardens.

ERRATUM.—In the letter entitled "Simple Huyghens' Apparatus for the Optical Lantern," in the issue of NATURE for April 9, instead of "a thickness of 1½ inches or more," read "of ½ inch or more."

OUR ASTRONOMICAL COLUMN.

THE SYSTEM OF CASTOR.—A very interesting discovery with regard to this well-known binary star has been made by Dr. Belopolsky (*Bull. Acad. Imp. Sci. St. Petersbourg*, vol. iv. No. 3). In addition to the two luminous bodies, which perform their revolution in a period of about 1000 years, Dr. Belopolsky's observations indicate that the brighter star, α_1 Geminorum, has a dark companion very similar to that of Algol, except that it never produces eclipses. The existence of this dark body was suspected in 1894, and it was fully confirmed by photographs of the spectrum taken at Pulkowa early in the present year, showing periodic changes in the velocity of the star along the line of sight. Thirteen photographs were obtained, and from these the velocities of α_1 Geminorum towards or away from the sun were deduced. Although the available data are insufficient for a complete determination of the orbit, it may be taken to be circular as a first approximation, and a period of revolution of 2·98 days sufficiently accords with the spectroscopic measurements. The proper motion of the system of α_1 is 1·0 geographical mile (=4·6 English miles) per second away from the sun, while the relative orbital velocity is 4·5 geographical miles (20·7 English miles) per second.

Dr. Belopolsky also tabulates the wave-lengths of some of the principal lines in the spectrum of α_1 Geminorum, which somewhat resembles that of Sirius in having broad lines of hydrogen, and many finer lines which are chiefly due to iron. α_2 Geminorum gives a spectrum with less numerous lines.

EFFICIENCY OF PHOTOGRAPHIC TELESCOPES.—Dr. Isaac Roberts has recently conducted an important series of experiments with the view of ascertaining the relative efficiency of a reflector and of portrait lenses for the delineation of celestial objects (*Monthly Notices*, vol. lvi. p. 372). It has often been asserted that portrait lenses have, by reason of their short focal lengths in relation to their apertures, greater photographic power than instruments of other forms; but this does not accord with Dr. Roberts's experience. A portrait lens of Dallmeyer's latest pattern, 3½ inches aperture and 9½ inches focus, and a 5-inch Cooke patent triplet lens of 19·2 inches focus, were attached with their cameras to the 20-inch reflector, and photographs of the same regions were taken simultaneously with the three instruments. The 5-inch lens was stopped down to a ratio of 1 to 4·8, while the ratio of aperture to focus in the case of the reflector was 1 to 4·9. In three exposures on the region of M. 33 Trianguli, the stars were 3½ times more numerous on the reflector photograph than on the photograph taken with the 5-inch lens in an equal angular area, and 7·8 times more numerous than in the case of the 3½-inch lens. At the same time the reflector photograph showed the nebula more extensively, more clearly depicted, at least two stellar magnitudes denser, and with far more structural details than can be seen on the other photographs.

Similar results were obtained with exposures on other regions, and in all cases the nebulosity shown on the plates taken with the reflector was denser than that registered by the portrait lenses in the approximate ratio of the relative numbers of faint stars shown on plates exposed simultaneously. Figures are also given which demonstrate the superiority of the reflector over the Willard lens, with which Prof. Barnard has obtained such striking photographs.

The experiments seem to point to a practical limit of about 1 to 5 for the ratio of aperture to focus in the construction of instruments for celestial photography. Dr. Roberts further concludes that it is not possible, as is often stated, that a photographic instrument of the portrait lens form can imprint images of nebulæ that are fainter than the faintest star-images imprinted at the same time and under exactly similar conditions.

SOLAR PHOTOGRAPHY AT MEUDON.—In his recent presidential address to the Astronomical Society of France, Dr. Janssen gave a few particulars as to the progress of solar photography at Meudon. The well-known photographs taken some years ago revealed much that was new in regard to the granulation of the photosphere, and as the work has been continued, it has been found that the faculæ, and even the striæ in the penumbra of a sun-spot, have a granular structure like the rest of the solar surface. One can look upon the granule, or small photospheric cloud, as an element of the photosphere just as the cell is that of organic tissues. These granular elements are very small, sometimes being only one or two-tenths of a second in diameter; and exceptionally favourable atmospheric conditions appear to be necessary for their proper investigation.

UNIVERSITY OBSERVATORIES IN AMERICA.—We learn from *Science* that at the last session of the Illinois Legislature an appropriation was made for the erection and equipment of an observatory for the State University at Champaign. The designs for the building were made, under direction of Prof. Ira O. Baker, by the Architectural Department of the University. The instrumental equipment, consisting of a 12-inch equatorial, a 3-inch combined transit and zenith telescope and a chronograph, will be made by Warner and Swasey, the optical parts being made by Brashear. This makes four universities which have established observatories within the past year, all of which have ordered telescopes from Warner and Swasey, with optical parts by Brashear. The list is as follows: University of Pennsylvania, Philadelphia (18-inch aperture); University of Ohio, Columbus (12-inch aperture); University of Minnesota, Minneapolis (10½-inch aperture); University of Illinois, Champaign (12-inch aperture).

INTERNATIONAL CATALOGUE OF SCIENCE.

WE have been requested to print the following circular, which the Royal Society has recently issued to the foreign and other delegates of various nations, now numbering about thirty, whose appointment has been already notified:—

"In anticipation of the forthcoming International Conference to consider the preparation of a catalogue of scientific literature by international co-operation, we are directed to address to you the following:—

"It is proposed that the Conference shall be held at the rooms of the Royal Society, Burlington House, London, *beginning on Tuesday, July* 14, 1896, at 11 a.m.

"One of the earliest acts of this first meeting will be to appoint an organising committee to determine the mode of procedure (including the language or languages to be used at the Conference), the course of business, and the way in which votes shall be recorded on occasions when it will be necessary to have recourse to formal voting.

"The Committee of the Royal Society hopes to be in a position to bring definite proposals before the Conference with regard to its main work. Meanwhile, we are directed to submit to your consideration the following provisional suggestions, and to invite remarks from you upon them:—

"I. That the proposed International Authors and Subject Catalogue of Scientific Literature shall be restricted, in the first instance, to branches of pure science, such as mathematics, astronomy, physics, chemistry, geology, zoology, botany, physiology, and anthropology, to the exclusion of applied sciences, such as engineering, medicine, and the like: the determination of the distinction between pure and applied science being left to the Conference.

"II. That in such an International Catalogue of Science all definite contributions to pure science shall be thoroughly indexed, whether occurring in books, memoirs, &c., treating of pure science, or in those devoted to applied or practical science—in other words, that the catalogue shall not be confined to papers published in certain periodicals, or to books of a certain category.

"III. That with regard to the form of the said Catalogue:—

"(*a*) There shall be a first issue of authors' titles, subject-matter, &c., in the form of *slips* or *cards*, which shall be distributed as speedily and as frequently as possible to subscribers generally.

"(*b*) That a further issue in book form, in a state for use as a permanent work of reference, shall take place at such intervals as may be determined on, parts corresponding to the several sciences being, if found desirable, published separately.

"IV. That, in order to secure the preparation and publication of such an International Catalogue, a Central Bureau shall be established under the control of an International Council.

"V. That the whole of the Catalogue shall be prepared and issued subject to the authority of the International Council, and that any particular undertakings which may be allotted to particular countries, institutions, or persons, shall be subsidiary to the work of the Central Bureau and subject to its control.

"VI. That the cost of preparing and publishing the said Slip- and Book-Catalogues at the Central Bureau during the years 1900–1904, in so far as these are not met by sales, shall be provided for by means of a guarantee fund, and that application be made to governments, learned societies, institutions, and individuals throughout the world, to assist in establishing such a fund.

"The Conference will also have to take into consideration the following matters, among others:—

"(*a*) Supposing that the plan of a Central Bureau is adopted, where shall the Bureau be placed?

"(*b*) The mode of appointment and organisation of the International Council in charge of the Bureau.

"(*c*) The language or languages to be adopted for the Catalogue.

"(*d*) The system of classification to be adopted in the subject index. It is suggested that the decimal system of Dewey may be so amended as to be worthy of adoption.

"There is necessarily the greatest difficulty in estimating the cost of the work in advance, or in forming an opinion as to the extent to which such an enterprise will be self-supporting. It will probably, therefore, be best to raise a guarantee fund covering a period of not less than five years, within which period it will undoubtedly be possible to determine the cost of the enterprise. The annual sum to be thus secured may be approximately estimated at ten thousand pounds.

"We are, your obedient servants,

"M. FOSTER, Secretary, R.S.
"RAYLEIGH, Secretary, R.S.
"E. FRANKLAND, Foreign Secretary, R.S."

THE FRENCH UNIVERSITIES.[1]

ON March 5 the Chamber of Deputies voted unanimously for a reconstitution of the French universities. In order to understand the object of this important law, it is necessary to recall the circumstances and the legislative proceedings which brought about its adoption.

Until 1875 the faculties of literature, science, law, and medicine existed separately in France, without being united by a single tie, even when four of them (a university, in the acknowledged sense of the word) existed in the same town. In 1875 the National Assembly announced the liberty of higher instruction, permitted the installation of free faculties, and accorded to the group of three faculties (refused to similar groups of the faculties of the State) the title of University. This vote increased at once, by reaction, the force of the movement, which, since the fall of the Empire, claimed unsuccessfully, by means of such men as Guizot, Cousin, Duruy, and Renan, the constitution of State universities. In 1877 a first scheme of law was handed over to M. Waddington, then Minister of Public Instruction, by a Committee of eminent men

[1] Condensed from an article in the *Revue de l'Université de Bruxelles*, February 1896.

and jurists, amongst whom were Renan, Taine, Berthelot, and others.

This led to the creation of seven complete universities, to which the nearest separate faculties attached themselves. M. Waddington, after having looked over the scheme, did not ask for a discussion. He thought that universities could not be established before university life had been founded, before the material, scientific, and moral situation of the faculties had been ameliorated. It is in this direction that the reforms were directed.

In 1885, the localities of the faculties having been changed, their scientific instruments being complete, their courses extended, at the cost of great pecuniary sacrifices, the question of universities was again renewed. The Minister of Public Instruction, at this time M. R. Goblet, signed two important resolutions. For each group of faculties there was instituted a general Council composed of two delegates of each faculty, with extended functions for academic, scientific, administrative, financial and disciplinary matters. The Rector of the Academy received the presidency. The ordinary life of the faculties of the same town was thus created. Each one of the faculties received, besides, confirmation of the right that they possessed since their creation, but which was repealed in deed to receive endowments, legacies and relief.

The faculties became therefore civil persons, but their grouping remained extra-legal, and had no judicial unity. It is in a scheme of law presented to the Senate in 1890 by M. Bourgeois, then Minister of Public Instruction, that the proposition is first made to confer the civil personality and the name of University on the groups, comprising at least the four faculties of law, literature, science and medicine, and to give to the universities the autonomy of their budget, by abandoning to them all the receipts which they effected (right of inscription, of study, revenues) for covering their expenses, with the help of a State subsidy. This project, rather badly received by the Senate, was sent back to a Commission, which very soon gave up its examination. It met with the strong opposition of the senators who represented the towns of the little groups of two or three faculties, which could not, by the terms of the project, pretend to the rank of University.

In spite of this repulse, the Minister of Public Instruction, and especially M. Liard, the eminent Director of Higher Instruction, were not discouraged. They succeeded in having inserted in the Finance Law of April 28, 1893, an article (No. 72) which conferred civil personality on the faculties in the same academic resort. The Senate, averse to the project of 1890, accepted the provision of 1893 by 212 votes against 56. Thus new progress was made.

Nevertheless, as it became more evident that the Senate would never consent to sacrifice the little groups of faculties, the partisans of the universities had to content themselves, in order to obtain anything, with demanding less.

In 1895, M. R. Poincaré presented the proposition which has just been voted for by the Chamber, and which he defended as Reporter, at the side of his successor in Public Instruction, M. Combes.

Briefly, in the terms of the project, the bodies of faculties, instituted in 1893, take the name of University; the general councils of the faculties, created in 1885, become councils of the university. In 1898 each faculty will have a budget of its own.

This arrangement has its importance, for it confers on certain groups of the university considerable receipts—646,000 francs at Paris, 105,000 at Bordeaux, 128,000 at Lyons, 83,000 at Lille.

By the vote of the Chamber, and that of the Senate, the universities, suppressed by the Revolution, will be reconstituted in France and endowed with civil personification. The new law is, on the other hand, but the result of the long evolution commenced twenty years ago. It perpetuates results already attained, and so little contested, that in 1889 M. Gréard, in his inaugural discourse at the Sorbonne, talked of the University of Paris, and the new buildings of the Faculties of Lille bear the inscription "University of Lille."

It is certainly to be regretted that the proposal of 1890 was not adoped. Real universities must include four faculties. And, as the Rector of the Catholic Institute of Paris, M. d'Hulst, has said at the Chamber, it is a delusion to call the union of only two or three faculties a university. It may be presumed that the incomplete groups, in order to maintain their new name and the concurrence of the complete groups, will try to give themselves the faculties which are wanting. If they do not succeed, they will remain, of necessity, in the shade; and it is better, in short, to see the faculties of Paris become a university, even if those of Clermont-Fenaud receive the same title, than to see the ambiguous situation, created in 1885, continued.

There are fifteen groups of faculties in France; there would, therefore, be fifteen universities, of which seven are complete: Paris, Lyons, Bordeaux, Toulouse, Montpellier, Lille, and Nancy. It is to be remarked that the southern half of the country will possess four of the seven universities. The incomplete universities are Aix-Marseilles, Rennes, Caen, Poitiers, Grenoble, Dijon (law, science, and literature), Clermont, and Besançon (science and literature).

The above-mentioned towns, Clermont and Besançon excepted, contain a preparatory school of medicine. Many of these schools will probably be turned into faculties.

NATIONAL ACADEMY OF SCIENCES.—WASHINGTON MEETING.

THE recent annual meeting of the National Academy of Sciences in Washington brought together an unusual number of members; and the papers read during the first three days of the meeting included several of special interest and value.

Naturally the Röntgen rays have been the prominent topic, and it is fortunate that most of the successful investigators have attended and read papers, or participated in the discussions. Some errors which have gained credence and wide publication have been corrected, and perhaps the most satisfactory feature of the discussion has been the elimination of these errors, and the correction of too hasty generalisation from experiments conducted without sufficient care.

What the rays are Prof. Rowland frankly admits we do not know, nor are we perceptibly nearer a solution of the problem than when Röntgen first launched his epoch-making essay.

Prof. Rowland presented to the Academy some notes on the rays, in which he said in part that investigators of the source of these rays generally overlook the fact that electrical currents are almost invariably accompanied by oscillations, so that each pole is alternately anode and kathode, thus vitiating any generalisations as to the anode or the kathode being the source of the rays. He mentioned that the rays are developed to the greatest extent when the kathode rays fall on the anode, and hence a kathode ground to a reflecting surface focused on the anode gives the best results. This fact is utilised in the construction of the "focus-tubes" now largly used in Röntgen photography.

Prof. Rowland has obtained good results by using perfect vacuum tubes in which the electrodes are brought within one millimetre of each other. The source of rays here is less than 1/1000 of an inch in diameter. This throws a shadow with remarkably sharp outline, being less than 1/1000 inch. The width of the image gives the limit of wave-length—if it is indeed an undulation, and not the projection of material particles—not greater than 1/8 the length of waves of yellow light.

A paper on the source of the Röntgen rays was read by Prof. A. A. Michelson and S. W. Stratton. Prof. Michelson maintains that these rays are not essentially different from those of Lenard. The latter produce their effect mostly within the tube, the former without; but Lenard also found an actinic effect outside the tube. He also brought forward evidence to show that Röntgen rays radiate in all directions from the surface first encountered by the kathode rays, and do not start from the anode.

Prof. A. M. Mayer read several papers. He showed that investigations of polarisation of these rays must be made with some very thin substance of low density, herapathite being the best; but this substance, which is an iodo-sulphate of quinine, is difficult to obtain. He described the process, already communicated by him to NATURE (April 2). On using plates of herapathite with three different exposures of half-hour, one hour, and three and a half hours, no polarising effect was produced. He remarked that calc-spar was utterly unavailable as a test of polarisation of these rays, because it could not be procured of sufficient thinness for the rays to penetrate, Hence the researches of some experimenters, though widely published, were of no value whatever. He has determined the density of herapathite with great accuracy and by repeated

experiments, and finds it much smaller than Herapath did, namely, 1·557.

Prof. Mayer also gave formulæ of transmission of Röntgen rays through glass, tourmaline and herapathite. To determine whether rays just go through or nearly go through, he uses a wire grating which will appear in the picture if rays go through. Transmission depends on the thickness of the glass plus the time of exposure. Glass of various thickness is used, one plate being superposed upon another in successive gradations. The eye cannot distinguish a difference less than about 1/100, and this is what passes through glass of five millimetres thickness. If we begin with glass 1/10 millimetre thick, it absorbs 1/10 of the rays, and each superposed 1/10 millimetre absorbs 1/10 of the residue, so that the formula in general is $I' = Ia^t$. It is evident, therefore, that there is no constant ratio of comparison of absorption by different materials, because the successive powers of "a" have not the same ratio to each other that the first powers have. In the case of herapathite the absorption (a) is found to be ·9382, so the formula becomes $I' = I \cdot 9382^t$. The formula for tourmaline is the same as for glass, so tourmaline is a very imperfect substance to use.

Prof. Ogden N. Rood read a paper detailing his experiments in reflecting the X-rays, which have enabled him to reflect 1/260th part of the rays incident on platinum at an angle of 45° (see NATURE, April 30, p. 614).

Prof. Arthur W. Wright read a paper on the relative permeability of magnesium and aluminium by Röntgen rays. He reported experiments showing that magnesium is much more permeable than aluminium. Magnesium is also more readily wrought than aluminium, thus making it much more desirable to use in the investigation of these rays.

Prof. T. J. J. See, of Chicago University, read a paper on double stars, giving results of three years' observations. He concludes that at the end of 115 years we know accurately only forty; that there is only evidence of disturbing bodies in a few cases, which are indecisive; that great eccentricity of orbit prevails, the average being twelve times as much as that of planetary orbits, and that the law of gravity is rendered probable and may be hereafter confirmed by spectroscopic investigation.

Among other papers read are:—The geological efficacy of alkali carbonate solutions, by E. W. Hilgard, read by G. Brown Goode; on the colour relations of atoms, ions, and molecules, by M. Carey Lea, read by Ira Remsen; on the characters of the Otocœlidæ, by E. D. Cope; on the determination of the coefficient of expansion of Jessop's steel, between the limits of 0° C. and 64° C., by the interferential method, by E. W. Morley and Wm. A. Rogers; on a remarkable new family of deep-sea Cephalopods (*Opistotenthis*), and its bearing on molluscan morphology, and on the question of the molluscan archetype, by A. E. Verrill; on *Pithecanthropus erectus* from the Tertiary of Java, which was discovered by Dubois in 1895, by Prof. Marsh; on the separate measurement, by the interferential method, of the heating effect of pure radiations and of an envelope of heated air, by Wm. A. Rogers; judgment in sensation and perception, by J. W. Powell; exhibition of a linkage whose motion shows the laws of refraction of light, by A. M. Mayer; location in Paris of the dwelling of Malus, in which he made the discovery of the polarisation of light by reflection, by A. M. Mayer. Ira Remsen read a paper on some studies in chemical equilibrium, and several papers were read by title.

The Academy adjourned to meet at New York, November 17, 1896.

WM. H. HALE.

THE MANUFACTURE OF ARTIFICIAL SILK.

LANCASHIRE is on the eve of some important expansions of the textile trades, for, from an interesting article in the *Times*, it appears that the manufacture of artificial silk from wood pulp will shortly be added to her industries. At present the wood-silk comes from France, large works having been established at Besançon under patents granted to Count Hilaire de Chardonnet, who discovered the process, and first established in 1893 the fact that it might be made into a commercial success. The demand for the new commodity increased so considerably that the idea of introducing its manufacture into England was mooted, with the result that a number of silk and cotton manufacturers met to discuss the question, and finally sent out to Besançon a deputation, consisting of some of their own number, an engineer, a chemist, and a lawyer, to investigate the subject thoroughly. This was done, and the outlook was found to be so promising that certain concessions have been secured and a company is now in process of formation, and, to begin with, a factory, which will cost £30,000, is to be built near to Manchester for the manufacture of artificial silk yarn from wood pulp, for sale to weavers, who will work it up by means of their existing machinery. The way in which wood pulp can be converted into silk yarn is explained in the *Times*. The pulp, thoroughly cleansed, and looking very much like thick gum, is put in cylinders, from which it is forced by pneumatic pressure into pipes passing into the spinning department. Here the machinery looks like that employed in Lancashire spinning sheds, except that one of the pipes referred to runs along each set of machines. These pipes are supplied with small taps, fixed close together, and each tap has a glass tube, about the size of a gas-burner, at the extreme point of which is a minute aperture through which the filaments pass. These glass tubes are known as "glass silkworms," and some 12,000 of them are in use in the factory at Besançon. The effect of the pneumatic pressure in the cylinders referred to above is to force the liquid matter not only along the iron tubes, but also, when the small taps are turned on, through each of the glass silkworms. It appears there is a scarcely perceptible globule. This a girl touches with her thumb, to which it adheres, and she draws out an almost invisible filament, which she passes through the guides and on to the bobbin. Then, one by one, she takes eight, ten, or twelve other such filaments, according to the thickness of the thread to be made, and passes them through the same guides and on to the same bobbin. This done, she presses them together with her thumb and forefinger, at a certain point between the glass silkworms and the guides. Not only do they adhere, but thenceforward the filaments will continue to meet and adhere at that point, however long the machinery may be kept running. In this way the whole frame will soon be set at work, the threads not breaking until the bobbin is full, when they break automatically, while they are all of a uniform thickness. The new product is said to take dye much more readily than the natural silk. The chief difference in appearance between the natural and the artificial silk is in the greater lustre of the latter. The success already secured by the new process in France is such that the introduction of the industry into Lancashire is expected to produce something like revolution in the conditions of trade there, not only by bringing into existence a new occupation, but also by finding more work for a good deal of the weaving machinery that is now only partially employed.

A THEORY OF THE X-RAYS.[1]

THE principal facts, which any satisfactory theory of the X-rays is called upon to explain, may be summarised as follows:

(1) The production of the rays by electric impulse, at the kathode,[2] in a highly exhausted enclosure.

(2) Propagation in straight lines and absence of interference, reflection, refraction and polarisation.

(3) The importance of density of the medium as the determining factor in the transmission of the rays.

(4) The production of fluorescence and actinic effects, and the action on electrified conductors.

Two theories have been proposed to account for these remarkable phenomena: (1) the theory of longitudinal waves; (2) the theory of projected particles.

In reference to the first theory it may be said that unless it is proved that an oscillatory discharge is essential to the production of the X-rays, there can be no reason for supposing that these rays are of a periodic nature—that they are wave-motion as commonly understood. The absence of interference, reflection and refraction is also a very formidable difficulty. Attempts have been made to account for the absence of these invariable accompaniments of every known form of wave-motion, but, as I think, with very indifferent success.

The most serious difficulty in the second theory is the attempt to explain the passage of the electrified particles of the residual gas (or of the electrode) through the walls of the

[1] From the *American Journal of Science*, April.

[2] Even should further experiment prove that the X-rays proper originat at the first obstruction encountered by the discharge, the fact remains tha this discharge originates at the kathode.

vacuum tube. The query at once arises, if glass is permeable to these particles in virtue of their relatively great velocity, why is it not permeable (in lesser degree) to the same particles moving with smaller velocities? That it is not, is evident from the fact that vacuum tubes retain their high degree of exhaustion unimpaired for years.

In view of these difficulties, I would propose a third theory, which may be called the "ether-vortex" theory.

Let it be supposed that the X-rays are vortices of an intermolecular medium (provisionally, the ether[1]). These vortices are produced at the surface of the kathode, by the negative charge, which forces them out from among the molecules of the kathode.

Let us now apply the tests above mentioned.

According to this theory, an oscillatory discharge, while it may be just as effective as a series of separate impulses, is not essential to the formation of the vortices. The vortices being forced outwards from the surface of the kathode by the negative charge, the effect of the positive charge at the anode would be to drive them in. Hence their appearance at the kathode alone.

One of the greatest puzzles connected with the behaviour of the X-rays is the fact that while they can pass almost unimpeded through air at atmospheric pressure (let alone water, glass, wood, flesh, bone, and metals) *when once outside the enclosure in which they are produced*, they cannot even reach the walls of the enclosure, except there be a very high vacuum within. This problem receives a very natural solution if it be considered that, in order that ether-vortices may result from the electrical impulse, this impulse must be communicated to them; and must not be dissipated in the interchange of molecular charges which accompanies, or rather produces, the discharge at moderate or high pressures.

As exhaustion proceeds there are fewer molecules present to effect this discharge with sufficient rapidity, and as this limit is approached there will be a division of the energy of the electric impulse between the electrified molecules and the ether-vortices, and in the end all the energy of the discharge will be confined to the latter.

The reason for the non-appearance of the rays under ordinary conditions is not that the rays cannot reach the walls of the enclosure or pass through them, but that they cannot form at all. The propagation of vortices in straight lines, the absence of interference phenomena, of reflection, refraction and polarisation, follow from the properties of vortices, and from the absence of anything corresponding to a wave-front. The passage of an ether-vortex through a mass of matter may be compared with a passage of a smoke-ring through a wire gauze screen or a series of such; and as the motion of the rings is more impeded the greater the diameter and the number of wires per unit volume, so, the greater the number and the size of the molecules—that is, the greater the density—the more effective will the medium be in dissipating the energy of the ether-vortices.

The production of fluorescence, actinic effects, and the dissipation of electric charges by light (which is an ether motion) would make it at least probable that similar (though perhaps not identical) effects would be produced by the motions of ether vortices.

Prof. J. J. Thomson has measured the velocity of kathode rays and obtained a result so very far less than the velocity of light as to preclude entirely the idea of there being any connection between the two. If these results can be made to apply to the X-rays, the analogy with the properties of smoke-rings would lead us to expect such a result. The kathode rays have been shown by Lenard to have a considerable range in their properties, depending on the mode of their origin.[2] It seems likely that their velocities are to a considerable extent dependent on the potential and the suddenness of the electrical impulse; and if this were shown to be true of the X-rays, it would be to that extent a confirmation of the theory.

The foregoing evidence may be considered scarcely sufficient to entitle the proposition here advocated to the dignity of a theory, but it may at least merit consideration as a working hypothesis which may serve as a guide in future experiment.

ALBERT A. MICHELSON.

[1] A possible objection occurs to the formation of ether-vortices in a medium which is usually considered free from viscosity; but the fact that vibrating molecules can and do communicate their motions to the surrounding ether shows that the communication of vortex motion may also be possible.

Though not a necessary part of the theory, it may be considered that the expulsion of the ether-vortices is due to an accumulation of ether in the kathode, and this would lend support to the theory that this accumulation is not merely a result of the negative charge, but that this excess of ether is what constitutes the negative charge.

[2] The distinction between the X-rays and the kathode rays appears to be somewhat artificial, and it seems probable that the X-rays are only kathode rays sifted by the various media they have traversed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Oxford University Junior Scientific Club will hold a conversazione on Tuesday evening, May 26. The rooms and laboratories of the University Museum, Oxford, will be thrown open by permission of the delegates and professors, and apparatus and experiments illustrating recent progress in the various branches of natural science will be exhibited. During the evening Prof. Silvanus P. Thomson will give a lecture on "Luminescence," with demonstrations.

On Tuesday, June 2, before the above Club, Prof. W. Ramsay, F.R.S., will deliver the fifth annual Robert Boyle Lecture, on "Argon and Helium, the two recently discovered gases." The "Robert Boyle Lecture" was instituted in 1892, and the lecturers hitherto have been Sir Henry Acland (1892), Lord Kelvin (1893), Prof. A. Macalister (1894), Prof. A. Crum Brown (1895).

The vacancies in the Public Examinerships in the Honour School of Natural Science have been recently filled up as follows:—In Animal Morphology, Prof. E. Ray Lankester and Mr. Adam Sedgwick; in Botany, Prof. D. H. Scott and Mr. R. W. Phillips; in Geology, Prof. A. H. Green and Mr. J. E. Marr; in Physics, Mr. R. E. Baynes; in Chemistry, Prof. W. Ramsay; and in Animal Physiology, Prof. C. S. Sherrington.

The Scholarships and Exhibitions advertised for proficiency in Natural Science are not numerous this year. Merton and New College offer each one, the examination to be held conjointly by the two colleges at the end of June. Magdalen offers one or more Demyships in Natural Science for competition in October, and the Delegacy of Non-Collegiate Students offers a scholarship for Chemistry. There seems to be a tendency at the present time to curtail the number of scholarships in Natural Science.

The Hope Professor of Zoology is giving a course of public lectures at the Museum, on the Hope Collections. The second lecture of the series will be given on Wednesday, May 27, at 2.30 p.m.

Prof. H. A. Miers, F.R.S., Waynflete Professor of Mineralogy, gave his inaugural lecture at the University Museum on Wednesday last.

A Decree will be proposed on the 26th inst. providing for the enlargement and alteration of certain rooms in the University Museum, in order that they may be adapted to the purposes of the Professor of Mineralogy.

Mr. G. F. Scott Elliot gave a lecture to the Ashmolean Society last Monday, on the race elements of South Africa.

CAMBRIDGE.—The dates of the examinations for entrance scholarships and exhibitions in Natural Science at the several colleges during the next academical year, have been announced as follows:—St. John's and Trinity, November 3, 1896; Pembroke, Caius, King's, Jesus, Christ's, and Emmanuel, November 17, 1896; Peterhouse and Sidney, Clare and Trinity Hall, December 8, 1896; Downing, April 20, 1897. The subjects are in General Chemistry, Physics, Zoology, Botany, Geology, and Physiology, two or more sciences being required. Application for particulars should be made to the respective tutors some weeks before the date of the examination. The yearly value of the scholarships varies from £80 to £40.

Vacancies for students of Biology at the University tables in the Zoological Stations of Naples and Plymouth are announced. Applications to occupy these are to be sent to Prof. Newton by May 27.

THE University of Utrecht will celebrate the 260th anniversary of its foundation on June 22 and five following days.

MR. JOHN H. ROCKEFELLER has given to Vassar College (women's) 100,000 dols. for a new building, to be either dormitory or recitation hall.

MR. ANDREW CARNEGIE has given to the city of Duquesne, Iowa, a library, gymnasium, and public bath. The buildings are to cost 150,000 dols.

THE following are among recent appointments:—Dr. Otto Fischer to be Extraordinary Professor of Physiological Physics at Leipzig; Dr. Albert P. Brubaker to be Assistant Professor of Hygiene in Jefferson College, Philadelphia; Dr. E. B. Sangree to be Professor of Pathology and Bacteriology in the Vanderbilt University, Nashville, Tenn.

THE new buildings at Owen's School for boys, Islington, which were recently opened by the Master of the Brewers' Company, include some new class-rooms for the teaching of practical science. There is a good science lecture-room, as well as physical and chemical laboratories, both well arranged and equipped. A new art room has also been added. The Brewers' Company have provided the funds for building, and the London Technical Education Board those for furnishing.

THE will of Mr. H. W. Massey, of Toronto, contains numerous bequests to charities and educational institutions. Among the latter are 50,000 dols. to the American University at Washington, for a building to bear his name; 10,000 dols. to the Alma Ladies' School at St. Thomas; 100,000 dols. to the University of Mount Allison at Sackville, N.B.; 50,000 dols. to the Wesleyan Theological College at Montreal; 200,000 dols. to the University of Victoria, Toronto; 100,000 dols. to the Wesleyan College of Winnipeg, Manitoba.

WE learn from the *Lancet* that Glasgow University is to receive under the will of the late Dr. John Grieve the sum of £8000, which is to be applied at the discretion of the court to the foundation of a lectureship, fellowship, or scholarship. The present demand for teaching in the subject of public health is very inadequately met by the existing laboratory arrangements, and the University Court has decided to equip a temporary laboratory until more satisfactory permanent dispositions are possible. Some recent communications with possible benefactors of the University render it probable that a lectureship in geology will shortly be instituted.

As we reported in our issue of February 20 of this year, it was decided by the County Council of Hampshire that the Finance and Technical Education Committees should meet together and report to the next meeting of the Council their opinion upon the manner in which the balance remaining after the annual expenditure on technical education had been defrayed, should be dealt with. At the meeting of the Council held on Monday, the 11th inst., the joint Committees reported that as an Education Bill had been introduced into Parliament dealing with the Local Taxation (Customs and Excise) Duties, they were of opinion that it would be undesirable to proceed with their deliberations. The report of the Technical Education Committee showed that good work had been done in the county during the past session.

ON Saturday, May 2, the new grounds of Columbia University were dedicated, and the corner-stones of Physics Hall and Schermerhorn Hall were laid. A large and distinguished company gathered to honour the events, among whom were the Governor of the State and the Mayor of the City of New York. Congratulations were sent by the President of the United States. The new grounds comprise about seventeen acres, commanding a fine view of the Hudson, and very near to and in sight of the tomb of General Grant. The site is that of the Battle of Harlem, fought September 16, 1776. On this site a group of buildings are now rising, which will provide admirably for the University, giving it facilities unrivalled by any other in America. Its endowment also places it in the front rank. The University has productive property in New York City valued at twelve million dollars, besides large endowments of personal property. Several of the new buildings are gifts—the library from the President of the University, Seth Low, Schermerhorn Hall from William C. Schermerhorn, and the Havemeyer building from the Havemeyer family. University Hall is to be built by gifts from alumni of the University.

THE Johns Hopkins University is only twenty years old, yet as regards excellence of work it ranks high among the leading universities in the world. A little brochure containing an account of the constitution and growth of the University has been published in commemoration of the recent twentieth anniversary. The fact that contributions amounting to more than a million of dollars have been received, is an indication that the foundation is firmly established in the confidence of the public. Nearly three thousand students have been instructed; three hundred of the graduates have been teachers in universities, colleges, and high schools, and altogether eight hundred persons who have been pupils of the University have been engaged in teaching; in fact, nearly every university and college in America numbers among its faculty a student of Johns Hopkins University. Since its opening, the University has encouraged the publication of the results of advanced scientific research. Several journals have been regularly maintained, and support has been given to many separate works. Among the most important serial publications are the *American Journal of Mathematics*, *American Chemical Journal*, *American Journal of Philology*, *Studies from the Biological Laboratory*, *Memoirs from the Biological Laboratory*, *Journal of Experimental Medicine*, and the *Johns Hopkins University Circulars*. Many separate publications have also been issued under the auspices, or with the aid, of the University, among the most noteworthy of these being Prof. Rowland's "Photographs of the Normal Solar Spectrum," "The Oyster in Maryland" (a publication in popular form of Prof. Brooks' investigation of the oyster and its relation to interests of Maryland), "Embryology of Insects and Arachnids," by Adam T. Bruce, "Geology and Physical Features of Maryland," by G. H. Williams and W. B. Clark, Bulletins and Reports of various departments of the Johns Hopkins Hospital, and a number of topographical and geological maps. For the study of the marine fauna of the Chesapeake region, including the oyster, the Chesapeake Zoological Laboratory, or Marine Station, was instituted in 1878, and a considerable sum of money annually appropriated for its maintenance. Further, the University annually nominates a scholar to occupy a table at Wood's Holl Biological Laboratory, for the prosecution of biological investigation. Thus in a variety of ways the University has fostered original research and sound instruction, and has therefore contributed to the welfare of Baltimore and the advancement of science.

SCIENTIFIC SERIALS.

American Meteorological Journal, April 1896.—A speculation in topographical climatology, by Prof. W. M. Davis. The author refers to certain relations between existing topographic features and climatic conditions, the study of which enable us to infer the vanished climates of the past by means of their still-preserved topographic products. He discusses at some length the records of arid and humid climates, the consequences of various glacial theories, &c., and suggests an exploration of the most critical regions by well-trained topographical climatologists, with the points at issue clearly in mind.—The new meteorological observatory on the Brocken, by A. L. Rotch. This observatory has an elevation of 3750 feet above the sea and is the highest mountain in Northern Germany. Observations, with some interruptions, were made between 1836 and 1869, and have now been resumed under the superintendence of the Prussian Meteorological Institute. The greatest difficulty in securing continuous observations is the frost, owing to which an anemometer cannot be kept in action, and much trouble is experienced with thermometers and rain-gauges; nevertheless, in addition to automatic records, direct observations are made thrice daily, from which important contributions will be added to our knowledge of the upper air. Further particulars of the work at this station will be found in *Die Natur* of the 26th ult. by Herr Koch, the Superintendent.

Bollettino della Società Sismologica Italiana, vol. i., 1896, No. 10 and 11.—Summary of the principal eruption phenomena in Sicily and the adjacent islands during the four months September to December, 1895, by S. Arcidiacono. For the whole year (1895) the following summary is given. Etna was covered by clouds on forty-six days; of the remainder, it was in a state of "emanation" on 172 days, and in a "strombolian" condition on 147 days. In Vulcano, Stromboli, and Salsi di Paternò, no change has occurred except that, on March 29, Stromboli passed from the normal to the explosive phase, at the same time a sensible earthquake was felt at several places in Calabria.—On a new type of seismometrograph, by G. Agamennone. The instrument consists of a pendulum of mass 200 kg. and length 16 metres, whose movements are magnified by the light horizontal lines at right angles to one another. When the first tremor occurs, the velocity of the strip of paper is increased from about 30 cm. per hour to about 5 mm. per second. The instrument is installed in the Central Meteorological and Geodynamical Office at Rome.—Notices of Italian earthquakes (August–October 1895), the most important being the Adriatic earthquake of August 9.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, May 8.—Captain Abney, President, in the chair.—Messrs. Frith and Rogers read a paper on the true resistance of the electric arc. It was pointed out by Prof. Ayrton, at the British Association meeting at Ipswich, that if the "true resistance" of an arc is defined as the ratio of a small increase of the P.D. between the carbons to the corresponding change in the current, it follows that this "true resistance" must be a negative quantity. In order to measure the "true resistance" without appreciably altering the form of the carbons, &c., the authors superpose a small alternating current on the main continuous current. The arc lamp employed was adjusted by hand, and the arc length was measured by projecting an image of the arc by means of a lens. The main (continuous) current and P.D. were measured by a Weston ammeter and voltmeter, while the auxiliary alternating current was measured by means of an air transformer and an electrostatic voltmeter. The authors find that between the limits employed the magnitude of the alternating current did not influence the results obtained for the resistance of the arc. The frequency, so long as it lies between the limits 250–7 complete alternations per second, and the wave form, do not influence the resistance, since the same results were obtained with a Pyke and Harris alternator, a Ferranti alternator, a Gramme alternator, and a Mordey transformer. For each make of carbon examined, four combinations were used:—+ cored, − cored; + cored, − solid; + solid, − cored; +solid, − solid. The general characteristic of the curves obtained is that for the + solid, − solid combination the "true resistance" is always negative; while for + cored, − cored it is always positive; the other curves lying between these two extremes, those which have the + carbon solid always being more negative than those which have the + carbon cored. In the case of the curves showing, for solid carbons, the relation between the resistance of the arc and the P.D. between the carbons, the current being constant (10 amperes), a minimum (maximum negative) value for the resistance occurs at about 55 volts. With combinations having a cored positive this minimum becomes more strongly marked, and occurs at a lower voltage. The authors find that for cored carbons the position of this minimum is closely connected with the presence or absence of the dark space in the arc. For points on the curve to the right of the minimum point, the dark space is absent; while for points to the left of the minimum, the dark space is always present. It was found that the effect of using as the + carbon a Carré carbon in which the core had been bored out, was to obtain a curve closely resembling that obtained when both carbons were solid. On filling this hollow carbon with plaster of Paris or kaolin, the resistance of the arc became positive. The above experiments were made with the + carbon uppermost; other experiments, made with the arc inverted, showed that with solid carbons the resistance is not appreciably altered by inverting the arc. With cored carbons, however, the resistance, as well as the physical character of the arc, is altered; since, on inversion, the dark space disappears, and the resistance considerably diminishes. If, however, the conditions under which the arc is burning are such that the dark space is absent, then inverting the arc does not alter the resistance. Attempts were made to measure the "true resistance" of a direct current hissing arc, but it was found that, even with the alternator at rest, there was a large deflection of the electrometer, showing that the current through a hissing arc was oscillatory. In order to elucidate the marked difference between their results for cored carbons and those deduced from Mrs. Ayrton's curves, the authors have made a series of measurements at low frequencies. They find that there is a critical frequency above which the resistance has a positive value which is independent of the frequency, and below which it has a negative value, this critical frequency lying between 7·5 and 0. In order to investigate the sign of the resistance at low frequencies, the vibrations of the needles of the ammeter and voltmeter were made use of. By an arrangement of mirrors, the needles and scales of both instruments could be observed simultaneously. In this way it could be seen whether the two needles were, at any instant, vibrating in the same or in opposite directions. If the needles vibrate in the same phase, *i.e.* if an increase of P.D. is accompanied by an increase of current, then the resistance must be positive; while if they are vibrating out of phase, *i.e.* if an increase of P.D. is accompanied by a decrease in current, then the resistance is negative. An attempt to run the arc off a continuous-current dynamo failed, since even with the alternator at rest the electrometer showed a large deflection, evidently due to the oscillation of the current, owing to the commutator of the dynamo having a finite number of segments. Prof. A. Gray doubted whether it was right to give the name "true resistance" of the arc to the slope of the curve connecting the potential difference (V) and the current (A). The authors' method of deducing $\delta V/\delta A$ was only true if the curve was a straight line; while in the case of the arc, E and a may both vary with the current. Mrs. Ayrton said, that with reference to the question of the existence of a back E.M.F. the evidence tended to show that it did not exist. By using an exploring carbon, no constant back E.M.F would be found. Prof. Ayrton said, that considering the arc as consisting of a back E.M.F. and a resistance, it was necessary to separate these two. Simply obtaining one value of the P.D. and the current was of no assistance in solving this question, but a series of values had to be taken. By taking the change in P.D. and current sufficiently small, the curve over the range considered was practically straight. It was curious to note that as long as observers obtained a positive value for the resistance of the arc, no fault was found with the method; but that now a negative value was found, the accuracy of this method was questioned. If a back E.M.F. does really exist, then it follows that the arc must have a negative resistance. Mr. Frith has shown why some people have got positive and some negative values for the resistance of the arc, and also that with an alternating current you may get either one or the other. Mr. Tremlett Carter asked if the fact that the arc had a negative resistance did not imply a back E.M.F. in order that the arc might be stable. If so, was a negative resistance such an absurdity? Mr. Campbell said he was very pleased to see that the authors had applied a method which he (Mr. Campbell) had suggested for measuring pulsating currents. If a pulsating current, such as could be obtained by means of a make and break, were passed through a thermopile, you would get a back E.M.F.; while if an alternating current were employed, you would not. Mr. Frith, in his reply, said that he had *defined* the "true resistance" as dV/dA. Mrs. Ayrton has shown that an arc will not run unless a certain resistance is placed in series with it; this resistance must be numerically equal to the negative resistance of the arc itself. Prof. Ayrton said Mr. Frith's remarks as to the cause of the want of stability of an arc without outside resistance, were most suggestive. The Chairman (Captain Abney) said he did not like the expression P.D. He suggested the employment of photography to facilitate the accurate registration of the instrument readings. The further discussion on the paper was adjourned to the next meeting on May 22.

Mathematical Society, April 23.—Major MacMahon, R.A., F.R.S., President, in the chair.—The President communicated a portion of the following abstract of a paper by Prof. W. Burnside, F.R.S., on the isomorphism of a group with itself. A one-to-one correspondence between the operations of a group, which leaves the multiplication table of the group unaltered, is spoken of as an isomorphism of the group with itself. Such a correspondence may clearly be represented as a substitution performed on the symbols of the operations of the group, *i.e.* the isomorphism may itself be regarded as an operation, and the totality of the isomorphisms of a given group will themselves form a group. This group is known as the "group of isomorphisms" of the given group. The only general theorems connected with the isomorphism of a group with itself hitherto published are due to Herr O. Hölder[1] and Herr G. Frobenius.[2] In the first part of the present paper I have reproduced such of the definitions due to Herren Hölder and Frobenius as are necessary to render it self-contained, and also one fundamental theorem. An isomorphism is defined to be cogredient or contragredient according as it can or cannot be obtained by transforming all the operations of the group by one of themselves. The theorem is that the cogredient isomorphisms form a self-conjugate sub-group of the complete group of isomorphisms. A definition, due to Herr Frobenius, involving an important new conception, is that of a characteristic sub-group. It is as follows. If a sub-group of a given group is transformed into itself by every isomorphism of which the given group is capable, the sub-group is called a characteristic sub-group. In the second part I have first

[1] *Cf.* The first ten pages of a memoir with the title "Bildung Zusammengesetzter Gruppen." *Math. Ann.*, xlvi.

[2] *Cf.* Parts of memoirs with titles "Ueber Endliche Gruppen" and "Ueber auflösbare Gruppen II." *Berliner Sitzungsberichte*, 1895.

investigated the conditions under which a group should have no characteristic sub-group. This condition is that the group should be generated by a number of holohedrically isomorphous simple groups, such that every operation of any one of them is permutable with every operation of all the rest; or, in the phraseology of Herr Hölder, the group must be the direct product of a number of holohedrically isomorphous simple groups. The following theorem is then proved. If G is a group which has no characteristic sub-group, and if R is the group of greatest order that contains G self-conjugately, while at the same time no operation contained in R, and not in G, is permutable with every operation of G; then the group R admits of no contragredient isomorphisms, and contains no self-conjugate operation except identity. A special case of this theorem is that the group defined by the congruences

$$\begin{aligned} x_1' &\equiv \alpha_{11}x_1 + \alpha_{12}x_2 + \ldots + \alpha_{1n}x_n + \beta_1, \\ x_2' &\equiv \alpha_{21}x_1 + \alpha_{22}x_2 + \ldots + \alpha_{2n}x_n + \beta_2, \quad \text{(Mod. } \lambda\text{, prime)} \\ &\ldots\ldots\ldots\ldots\ldots\ldots \\ x_n' &\equiv \alpha_{n1}x_1 + \alpha_{n2}x_2 + \ldots + \alpha_{nn}x_n + \beta_n, \end{aligned}$$

dmits only cogredient isomorphisms. In the third part I consider the group of isomorphisms of certain simple groups, some of whose properties I have already dealt with in vol. xxv. of the Society's *Proceedings*. For the simple group of order $2^n(2^{2n}-1)$ there defined, I show that the order of the group R of isomorphisms is $2^n(2^{2n}-1)n$, and that if H is the group of cogredient isomorphisms, the factor group R/H is a cyclical group of order n. For the simple groups of order $\frac{1}{2}\lambda^n(\lambda^{2n}-1)$, λ an odd prime, it is shown that the order of the group R of isomorphisms is $\lambda^n(\lambda^{2n}-1)n$, the factor group R/H being the direct product of cyclical groups of orders 2 and n. The latter class includes as a special case, $(\lambda^n = 3^2)$, the alternating group of six symbols. In Herr Hölder's paper, referred to above, the isomorphisms of the alternating group are dealt with, and, as compared with all other degrees, it is found that the alternating group of degree 6 behaves exceptionally, and requires rather elaborate treatment. There seems, however, to be no reason for regarding the alternating groups of different degrees as a set of groups which are characterised by common group-properties in the same way, for instance, as the groups of the modular equation for different prime transformations are; and this view is borne out by the fact that there is nothing exceptional in the behaviour of the alternating group of degree 6 when regarded as one of the class of groups here considered. —The President also read an abstract of a paper on division of the Lemniscate, by Prof. G. B. Mathews.—Dr. Hobson, F.R.S., read a paper on some general formulæ for the potentials of ellipsoids, shells, and discs.—The President offered some remarks on the compensation for difference of capital in gambling *à outrance*, being a contribution to the theory of the "Duration of Play."—Mr. Basset, F.R.S., read a paper on the stability of a frictionless liquid and the theory of critical planes. In the theory of the stability of the steady motion of a frictionless liquid which is bounded by the parallel planes $y=0$ and $y=a$, the disturbed motion depends upon the equation

$$(n/k + U)(d^2v/dy^2 - k^2v) = vd^2U/dy^2 \quad \ldots \quad (1)$$

The usual process of solution fails whenever there is a plane, called a *critical* plane, at which $n/k + U = 0$, and the object of this paper is to examine the nature of the solution when such a plane exists. In steady motion $U = \phi(y)$, where ϕ is a given function; and if a critical plane exists, $-n/k = \phi(c)$, which determines the relation between the time-constant n and the wave-constant k, provided a *real* value of c can be found which lies between 0 and a. The integral of (1) is of the form

$$v = Af_1(y) + Bf_2(y).$$

The boundary conditions require that $v=0$ when $y=0$ and $y=a$. At a critical plane $d^2U/dy^2=0$ or $v=0$. If the first condition is satisfied, and if neither of the functions f become infinite between $y=0$ and $y=a$, the boundary conditions enable the constants A and B to be eliminated, which leads to a relation of the form $F(a, k, c)=0$, and the conditions for the existence of a critical plane require that this equation should furnish at least one *real* value of c lying between 0 and a. But if one of the functions—say f_2—becomes infinite between the limits, B=0, and the boundary conditions cannot usually be satisfied, in which case a critical plane cannot exist. When the form of U is such that d^2U/dy^2 does not vanish when $y=c$, a critical plane cannot exist except in very special circumstances. The paper concludes by showing that the particular solutions obtained by the hypothesis that x and t enter into the solution in the form of the factor $e^{ikx+int}$ can always be generalised by Fourier's theorem, so as to include every possible disturbance which does not violate the boundary conditions. The author and Mr. Love, F.R.S., joined in a discussion on the subject of the communication.

Geological Society, April 29.—Dr. Henry Hicks, F.R.S., President, in the chair.—Descriptions of new fossils from the carboniferous limestone. (1) On *Pemmatites constipatus*, sp. nov., a lithistid sponge. (2) On *Palæacis humilis*, sp. nov., a new perforate coral; with remarks on the genus. (3) On the jaw-apparatus of an Annelid, *Eunicites Reidii*, sp. nov., by Dr. G. Hinde.—(1) The *Pemmatites*, belonging to genus hitherto only known from the Permo-Carboniferous beds of Spitzbergen, was discovered in the Yoredale beds of Yorkshire by Mr. J. Rhodes, and is the only fairly complete sponge which has hitherto been detected in the Yoredale beds of North-west Yorkshire. The author gave a full description of the species. (2) The *Palæacis* was found by the Rev. G. C. H. Pollen in the carboniferous limestone and shale series, on the banks of the Hodder, near Stonyhurst. The specific characters of the form were given by the author, who, in the light of the new information, gave a fresh definition of the genus *Palæacis*, which appears to represent a distinct family of perforate corals, in some features more nearly allied to the Favositidæ than to the Madreporidæ or Poritidæ. (3) The third specimen was discovered by Miss Margery A. Reid in the Lower Carboniferous beds of Halkin Mountain, Flintshire, and is named in honour of its discoverer. A description of it was given, and it was stated that, notwithstanding certain peculiarities, the individual pieces correspond so closely with those of the recent *Eunice* family that it may well be included in the genus *Eunicites*.—The Eocene deposits of Dorset, by Clement Reid. The new survey of the western end of the Hampshire basin shows that the Reading beds become fluviatile and gravelly in Dorset (as was already known), and contain, in addition to chalk flints, many fragments of Greensand chert. The London clay thins greatly and becomes more sandy, but is apparently still marine. The Bagshot sands become coarser and more fluviatile, changing rapidly west of Moreton Station, till they consist mainly of coarse subangular gravel. These gravels, formerly referred to the Reading series, are now shown to be continuous with the Bagshot sands, which as they become coarser cut through the London clay and Reading beds to rest directly on the chalk. The Bagshot gravels contain, besides chalk flints and Greensand chert, fragments of Purbeck marble and numerous Palæozoic grits and other stones probably derived from the Permian breccias of Devon.—Discovery of mammalian remains in the old river-gravels of the Derwent near Derby, Part i., by H. H. Arnold-Bemrose. A few mammalian bones were found in sinking a well at Allenton. On April 8, 1895, the authors commenced further excavations, and were successful in finding a number of bones of a *Hippopotamus*, an *Elephas*, and of a *Rhinoceros*. They were found in a dark-coloured sand above the river-gravel, at a depth of 9 feet 8 inches below the surface. Mr. Clement Reid found some twenty or more species of plant-remains in the sand. These plants "indicate a moist meadow or swampy ground, and a temperate climate. The species are all widely distributed." Part ii., by R. M. Deeley. The deposits in which the bones were found occupy a wide trench which occurs on the inside edge of a gravel-terrace stretching for several miles south of Derby, at a height of 15 or 20 feet above the modern alluvial plain. The gravels are of later age than the great chalky boulder clay, and were formed at a time when the rivers were removing from their preglacial valleys the older boulder clays, with which they had been partially filled. Gravels of two ages are recognised: (*a*) recent gravels well stratified, undisturbed, and covered in many places by a thick layer of brick-earth; and (*b*) high-level gravels showing "trail" and contorted bedding. It is in these latter gravels that the trench containing the mammalian remains occurs.

Zoological Society, May 5.—Dr. John Anderson, F.R.S., Vice-President, in the chair.—Mr. W. E. Hoyle exhibited a Röntgen-ray photograph of a snake in the act of swallowing a mouse.—Mr. G. A. Boulenger, F.R.S., read a paper on some little-known Batrachians from the Caucasus, based chiefly on specimens recently transmitted to the British Museum by Dr. Radde, of Tiflis. Among these was an example of the new frog of the genus *Pelodytes*, for which he had proposed the name *P. caucasicus*. Altogether ten species of Batrachians

were now known from the Caucasus.—Mr. F. E. Beddard, F.R.S., read the second of his contributions to the anatomy of Picarian birds. The present communication related to the pterylosis of the *Capitonidæ*.—Mr. M. F. Woodward read a paper on the dentition of certain Insectivores, and pointed out that there was strong evidence to show that the milk-dentition was undergoing reduction in this group as a whole, some of the milk-teeth in *Erinaceus* and *Gymnura* being present as small calcified tooth-vestiges only, while in *Sorex* there were apparently no calcified milk-teeth, but only vestigial milk-enamel organs.—A communication from Mr. A. D. Bartlett contained some notes on the breeding of the Surinam Toad (*Pipa americana*,) as recently observed in the Society's Gardens. It had been observed that the eggs when issued from the cloaca of the female, which was protruded into a bladder-like process during their production, were arranged on the back of the female by the action of the male.

Anthropological Institute, May 12.—Mr. E. W. Brabrook, President, in the chair.—Mr. H. W. Seton-Karr exhibited and made remarks on a collection of stone implements discovered by him in Somaliland. Sir John Evans, Prof. Rupert Jones, and Mr. C. H. Read spoke and complimented Mr. Seton-Karr upon his discovery.—Dr. J. G. Garson read a paper on recent observations on the Andamanese by Mr. M. V. Portman. A discussion followed, during which remarks were made by Sir William Flower, Prof. Keane, Mr. C. H. Read, and Prof. Brigham of Honolulu. Dr. Garson read another paper on photographic apparatus for travellers, and exhibited a number of cameras of various designs.

EDINBURGH.

Royal Society, May 4.—Prof. M'Kendrick in the chair.—Dr. John Macintyre made a further communication describing new results with the X-rays. Some of these have already appeared in NATURE (vol. liii. p. 614). He found that his coil gave better results when a mercury interrupter was used, and, on regulating this to give one flash in the tube, he was struck by the peculiar colour of the discharge. He exhibited a photo of the hand taken with one flash, which was quite distinct. With ten flashes it was excellent. What the exposure would be in the case of one flash, he could not say. He had tried the effect of the rays on tourmaline, but could find no trace of polarisation. Prof. M'Kendrick said he had satisfied himself that the rays had no effect on the electric phenomena of the pulsating heart, nor on the motor nerves, but that they had an influence on the currents referable to the retina.—Dr. J. C. Dunlop read a paper on the action of acids on the metabolism. He showed them to have a marked diuretic action, to affect the acidity of the urine only slightly, the acidity being to a great extent neutralised by an increased alkali excretion, and to produce an increased excretion of nitrogen as pre-formed ammonia and extractives, but not as urea. His results did not agree with those of Dr. Haig in the same field.—The Secretary read a paper on clouds, by Mr. John Aitken.—Dr. C. G. Knott read a paper by Prof. J. M. Dixon, on a graphical representation of emotion as expressed in rhythm. The author plotted a graph of the number of syllables in each stanza of Browning's "Abt Vogler," and endeavoured to deduce from the graph the variations in Browning's feelings. Other specimens were treated similarly.

PARIS.

Academy of Sciences, May 11.—On the *rôle* of the induction ring of iron in dynamo-electric machines, by M. Marcel-Deprez. A discussion as to the cause of the effect produced by the ring of iron in dynamos of the Pacinotti type. Some experiments are cited which tend to show that the explanations usually given in text-books are insufficient. The complete theory will be given in a future paper.—Nitrates in potable waters, by M. Th. Schlœsing. The results are given of a large number of determinations of nitrates and of calcium in potable waters from various sources. Curves are given showing the variations of these with the season.—On the crepuscular phenomena, and the appearance of the dark face of Venus, by M. Perrotin.—On regular non-linear substitutions, by M. Antoine.—An elementary demonstration of a theorem of M. Picard on complete functions, by M. E. Borel.—Remarks on the preceding communication, by M. Picard.—On the periodic solutions of the problem of the movement of a body suspended by one of its points, by M. G. Kœnigs.—On the rotation of solids and Maxwell's principle, by M. R. Liouville. An examination of a case for which Maxwell's principle does not hold good.—Observations concerning the note of M. Dongier on a method of measuring double refraction, by M. G. Friedel. It is pointed out that the method of M. Dongier was anticipated by the author in 1893.—On the lowering of the explosive dynamic potential by ultra-violet light, and the interpretation of certain experiments of M. Jaumann, by M. R. Swyngedauw. The study of the influence of the rate of variation of potential upon the explosive potential must be made in the absence of ultra-violet light. The neglect of this precaution vitiates the results obtained by M. Jaumann.—On the condensation of dark light, by M. G. Le Bon. Two plates of metal (copper and lead), after exposure to an electric arc for an hour, were made to enclose a negative and a sensitive plate, the faces that had not been exposed to the light being inwards. Precautions were taken to eliminate the possible effects of heat and of contact. That the resulting image must have been caused by something stored on the surface of the metal plates during the exposure to the arc lamp, was definitely proved by the negative results of parallel experiments with plates not exposed to the arc lamp.—The action of hydrogen bromide upon thiophosphoryl chloride, by M. A. Besson (see Notes, p. 63).—The action of air and of peroxide of nitrogen upon some halogen compounds of bismuth, by M. V. Thomas. The halogen compounds studied included the tribromide, triiodide, and the dichloride, which yielded as ultimate products bismuth oxybromide, bismuthic oxide, and bismuth oxychloride respectively.—Action of ethyl-oxalyl chloride upon the aromatic hydrocarbons in presence of aluminium chloride, by M. L. Bouveault. Under suitable conditions this reaction readily results in the production of ethyl phenyl-glyoxylate, or its derivatives.—On a new method of separating the methylamines, by M. Marcel-Delépine. The mixture of amine hydrochlorides is boiled with caustic soda, and the gases passed into commercial formaldehyde. This distillate is now heated with caustic soda, and, after drying, submitted to fractional distillation. Three principal fractions are obtained, at 15°–20°, 67°–68°, and 166° C. The first is trimethylamine, and the two latter, on heating with alcoholic hydrochloric acid, yield the pure hydrochlorides of dimethylamine and methylamine. The separation is more perfect than in the classical method with ethyl oxalate.—On the Synascidia of the genus *Colella*, and the polymorphism of their buds, by M. Maurice Caullery.—On the nephridia of *Branchiobdella varians* (var. *Astaci*), by M. D. N. Voinov.—Formation of an anti-coagulating substance by the liver in presence of peptone, by M. C. Delezenne.—On the effects produced on certain animals by the toxins and anti-toxins of diphtheria and tetanus injected into the rectum, by M. P. Gibier. Toxins and anti-toxins injected *per rectum* are without any effect, and appear to be destroyed or retained by the rectal mucus. For the animals used in the experiments (rabbit, dog, and guinea-pig), the toxins did not poison, and the anti-toxins conferred no immunity.—Hydrographical researches of M. Spindler in Lake Peypous, by M. Venukoff.

PHILADELPHIA.

Academy of Natural Sciences, March 31.—Prof. Henry A. Pilsby called attention to a fine collection of barnacles obtained from the bottom of a vessel recently returned from a voyage to Hong Kong from San Francisco and back, by way of Java and India. *Balanus tintinabulum* was the commonest of the species represented, the varieties *zebra* and *spinosus*, although growing under identical conditions, retained their individuality perfectly.—The question of the constancy of varietal characters was debated by Messrs. Sharp, Pilsby, and Heilprin.—Mr. Pilsby also described a specimen of *Pugnus parvus*, a ringiculate mollusc. The species is involute, a unique character, none of the fossil forms of the family possessing it. He also described a Central American Melanian, under the name *Pachycheilus Dalli*. It is distinguished by a remarkable double sinuation of the outer lip, which has a deep and wide pleurotonoid sinus above, and a rounded projecting lobe in the middle, below which it is again retracted.—On the nomination of the Entomological Section, Dr. Henry Skinner was elected Professor in the Department of Insecta. In response to an invitation from the Committee having charge of the celebration of the fiftieth year of Lord Kelvin's tenure of office as Professor of Natural Philosophy in the University of Glasgow, General Isaac Jones Wistar was appointed to represent the Academy on the occasion.

March 25.—Dr. George H. Horn made a communication regarding the synonymy of the Elateridæ. He specially described the prosternum of Ludius. A Lower California form had the pro-

sternum of different shape from that of other members of the genus, the mesosternum being more protuberant. It will probably be referred to Probothrium.—Mr. Chas. S. Welles exhibited specimens of the larva of *Harrisimemna trisignata*. When full-grown they bore into wood preparatory to changing into chrysalids.—A paper was read entitled "The breeding habits of *Periplaneta orientalis*," by C. Few Seiss. Three females deposited twenty-five egg-cases. Each of these contains sixteen eggs, so that a new generation of 400 cockroaches was represented by the deposit. The first of these egg-cases were dropped May 5 and May 14, 1895, and were hatched November 9. In most cases the deposits were dropped with no attempt at concealment, although in a few instances they were placed in little trenches made by the insect, and then covered up. The development of the capsules was described. The young, probably, receive no maternal care or protection.—Mr. Lancaster Thomas exhibited an improved form of insect net-frame made from a continuous piece of rounded aluminium wire.—Mr. Westcott suggested linoleum as a substitute for cork in the arrangement of insects.—Dr. Henry Skinner called attention to a fungus, *Polyporus betulinus*, which might be used for the same purpose with advantage.—Mr. William J. Fox stated that about ninety species of Hymenoptera, six of which were perhaps new to science, were included in the collections of insects brought by Dr. A. Donaldson Smith from Western Somaliland, Africa.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, MAY 21

ROYAL SOCIETY, at 4.30.—On the Changes produced in Magnetised Iron and Steels by cooling to the Temperature of Liquid Air: Prof. J. Dewar, F.R.S., and Dr. J. A. Fleming, F.R.S.—Note on the Larva and of the Post-Larval Development of Leucosolenia variabilis, H. Sp., with remarks on the Development of other Asconidæ: E. A. Minchin.—Helium and Argon. Part III. Experiments which have yielded Negative Results: Prof. Ramsay, F.R.S., and Dr. Collie.—On the Amount of Argon and Helium contained in the Gas from the Bath Springs: Lord Rayleigh, Sec.R.S.

ROYAL INSTITUTION, at 3.—The Art of Working Metals in Japan: W. Gowland.

CHEMICAL SOCIETY, at 8.—The Diphenylbenzenes. I. Metadiphenylbenzene: F. D. Chattaway and R. C. T. Evans.—Derivatives of Camphoric Acid: Dr. F. S. Kipping.—Some Substances exhibiting Rotatory Power, both in the Liquid and Crystalline states: W. J. Pope.

FRIDAY, MAY 22.

ROYAL INSTITUTION, at 9.—Hysteresis: Prof. J. A. Ewing, F.R.S.

PHYSICAL SOCIETY, at 5.—On Dielectrics: R. Appleyard.—The Field of an Elliptical Current: J. Viriamu Jones.—An Instrument for Measuring Frequency: A. Campbell.

SATURDAY, MAY 23.

GEOLOGISTS' ASSOCIATION (Paddington, at 11.45).—Excursion to Chippenham, Calne, Kellaways, and Corsham.

YORKSHIRE NATURALISTS' UNION, at Hellifield.—Four Days' Excursion for the investigation of Bowland.

MONDAY, MAY 25.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

TUESDAY, MAY 26.

ROYAL INSTITUTION, at 3.—The Building and Sculpture of Western Europe: Prof. T. G. Bonney, F.R.S.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Apparatus for Photography on Small Plates (smaller than Quarter Plates).

WEDNESDAY, MAY 27.

GEOLOGICAL SOCIETY, at 8.—On the Pliocene Deposits of Holland, and their relation to the English and Belgian Crags, with a Suggestion for the Establishment of a New Zone—"Amstelien"—and some Remarks on the Geographical Conditions of the Pliocene Epoch in Northern Europe: F. W. Harmer.—The Lingula-Flags and Igneous Rocks of the Neighbourhood of Dolgelly: Philip Lake and S. H. Reynolds.—The Kildare Inlier: C. J. Gardiner and S. H. Reynolds.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MAY 28.

ROYAL INSTITUTION, at 3.—Lake Dwellings: Dr. Robert Munro.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Utilisation of Water-Power, especially with a Small Fall, with some Examples of Plants for the Generation of Electrical Energy: Alph. Steiger.

CHEMICAL SOCIETY, at 8.—Lothar Meyer Memorial Lecture: Prof. P. Phillips Bedson.

SATURDAY, MAY 30.

ROYAL INSTITUTION, at 3.—The Moral and Religious Literature of Ancient Europe: Dr. E. A. Wallis Budge.

ROYAL BOTANIC SOCIETY, at 3.45.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Evolution of Bird-Song: C. A. Witchell (Black).—Meteorological Results of the Observations taken at the Bangalore, &c., Observatories, 1893-94: J. Cook (Bangalore).—Earth Knowledge: W. J. Harrison and H. R. Wakefield, Part 2 (Blackie).—The Flora of the Alps: A. W. Bennett, 2 Vols. (Nimmo).—Attaque des Places: Lieut.-Colonel E. Hennebert (Paris, Gauthier-Villars).—La Spectroscopie: Prof. J. Lefèvre (Paris, Gauthier-Villars).—Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere: Dr. O. Schultze, Erste Hälfte (Leipzig, Engelmann).—Southall's Organic Materia Medica: J. Barclay, 5th edition (Churchill).—Schlich's Manual of Forestry. Vol. v. Forest Utilization: Prof. Fisher (Bradbury).—Water Supply: Prof. W. P. Mason (Chapman).—A Dictionary of the Names of Minerals: Prof. A. H. Chester (Chapman).—Leerboek der Organische Chemie: Dr. A. F. Holleman (Groningen, Wolters).—The Elements of Physics: E. L. Nichols and W. S. Franklin. Vol. 1. Mechanics and Heat (Macmillan).—Memoirs of Frederick A. P. Barnard: J. Fulton (Macmillan).—Nature's Byepaths: Dr. J. E. Taylor. 6th edition (W. H. Allen).—The Aquarium: Dr. J. E. Taylor, 6th edition (W. H. Allen).—Mathematical Papers read at the International Mathematical Congress held in connection with the World's Columbian Exposition, Chicago, 1893 (New York, Macmillan).—Stanford's Compendium of Geography and Travel, new issue. Asia, Vol. 1: A. H. Keane (Stanford).—Gehirn und Seele: Dr. P. Flechsig (Leipzig, Veit).

PAMPHLETS.—Remarkable Eclipses: W. T. Lynn (Stanford).—The Old Light and the New: W. Ackroyd (Chapman).—Nineteenth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois (Springfield, Ill.).

SERIALS.—Engineering Magazine, May (Tucker).—Science Progress, May (Scientific Press).—Strand Magazine, May (Newnes).—American Naturalist, May (Philadelphia).—Bulletin of the American Mathematical Society, April (New York, Macmillan).—Journal of the Chemical Society, May (Gurney).—Journal of the Royal Microscopical Society, April (Williams).—Astrophysical Journal, May (Chicago).—Royal Natural History, Part 31 (Warne).

CONTENTS.